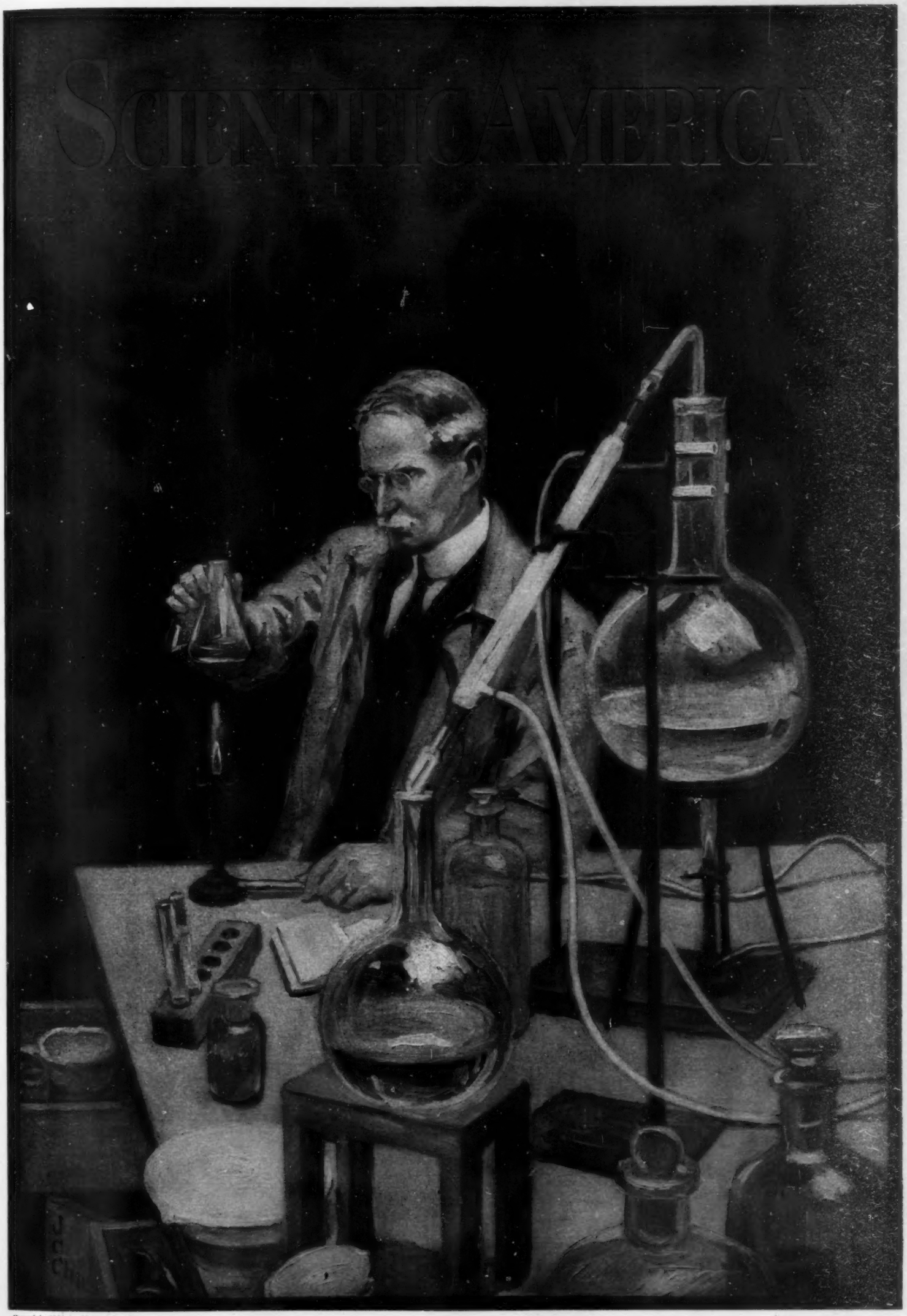
INDUSTRIAL CHEMISTRY



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New York, N. Y.

Price
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Overland

A Book That Fully Explains Why We Can Build a 30-Horsepower 5-Passenger Fore-door Touring Car to Sell for $900. Write for a Copy.

IT is utterly impossible for any one to realize the economical manufacturing strength of the *Overland* organization without a clear idea of its enormous manufacturing facilities. To the average man an automobile factory is merely a factory---a place where cars are made. Yet there is the greatest difference in the world. On one hand you have a plant which, on account of its great production, can make and sell its car for far less than the other factory. And on the other hand you might have a very small factory which, while it produces a good car, has a very small capacity, and its car for car production costs are considerably higher than those of the larger plant. That is why you find one manufacturer selling his 30-horsepower touring car for $1250 while we market that type of machine for $900.

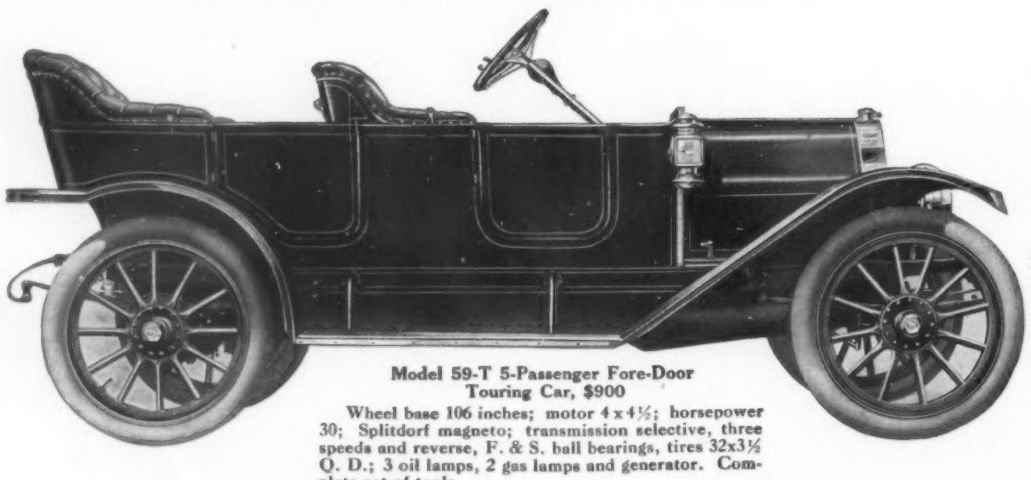
¶ We have just published a very thorough book which explains in a clear, definite and readable manner the difference in automobile plants. And the point of this whole book is to prove the economical manufacturing ability of the Overland plants—to prove its strength by showing and explaining to you the interior and exterior of the greatest automobile plant in the world. It takes you over the entire 80 acres. It takes you in shops and departments that will not be found in other plants. It explains and illustrates the giant Olsen tensile strength testing machine of 100,000 pounds capacity for testing raw metals. It shows you what a White-Souther endurance tester is. It takes you through the chemical laboratories and the great drop forge plant—the largest in the industry. It takes you through what will seem like miles of automatic machinery. It shows you how it takes four months to produce an Overland car and how thorough, accurate and painstaking each operation is. The book is free and we want you to have one. It is interesting and full of information. Anyone can read it for it is written in words of few syllables.

¶ Above all it gives you a clear understanding of economics in the production of automobiles in great quantities, and we believe it proves why no other manufacturer in the business can produce the car described below and sell it at our price without losing money. To realize this you have but to compare this automobile with any other similar car on the market. Take the entire list of specifications and see if you can duplicate this car for less than $1250. Check the whole car, the wheel base, the motor, the seating capacity, the body finish, the transmission, the design, etc. Do this and the exceptional value of this car will show you where to invest your money. Our Model 59 is the most progressive step the industry has ever witnessed and it means a great deal to the motor buyers of America.

¶ A line to us will bring you this new Overland book. It explains what we are and what we have got and why other cars of similar size and rating are from twenty to forty per cent. higher in price.

¶ Write and ask for book **F29.**

The Willys-Overland Company, Toledo, Ohio



Model 59-T 5-Passenger Fore-Door Touring Car, $900

Wheel base 106 inches; motor 4x4½; horsepower 30; Splitdorf magneto; transmission selective, three speeds and reverse, F. & S. ball bearings, tires 32x3½ O. D.; 3 oil lamps, 2 gas lamps and generator. Complete set of tools.

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Chemistry gave us a knowledge of Vanadium; commerce furnished us a plentiful supply of Vanadium ores, and metallurgy perfected the application of Vanadium Alloys.

In an age of alloy steels, Vanadium is the *Master Alloy*. And this is why:

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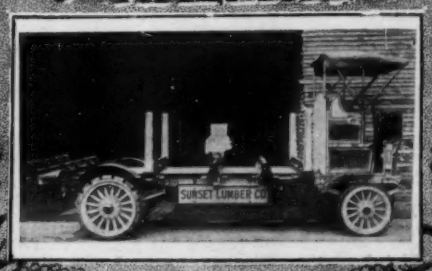

THE illustrations in the above group show five distinct types of the "Mack," each model built to conform to the special requirements, characteristic of the line of business for which it is used. We build the "Mack" in sizes of 1, 1½, 2½, 3½, 5 and 7 tons capacity. Each truck is given a rigid "third degree" test before leaving factory, making absolutely certain of its efficiency to perform the work for which it is intended. We'd like you to know more about the "Mack," the ease with which it carries heavy loads over all kinds of roads under the most trying weather conditions, its economy of operation and many distinctive "Mack" merits. We have compiled all this information in handy book form with photographic engravings, a copy will be mailed you at request. Write to day.

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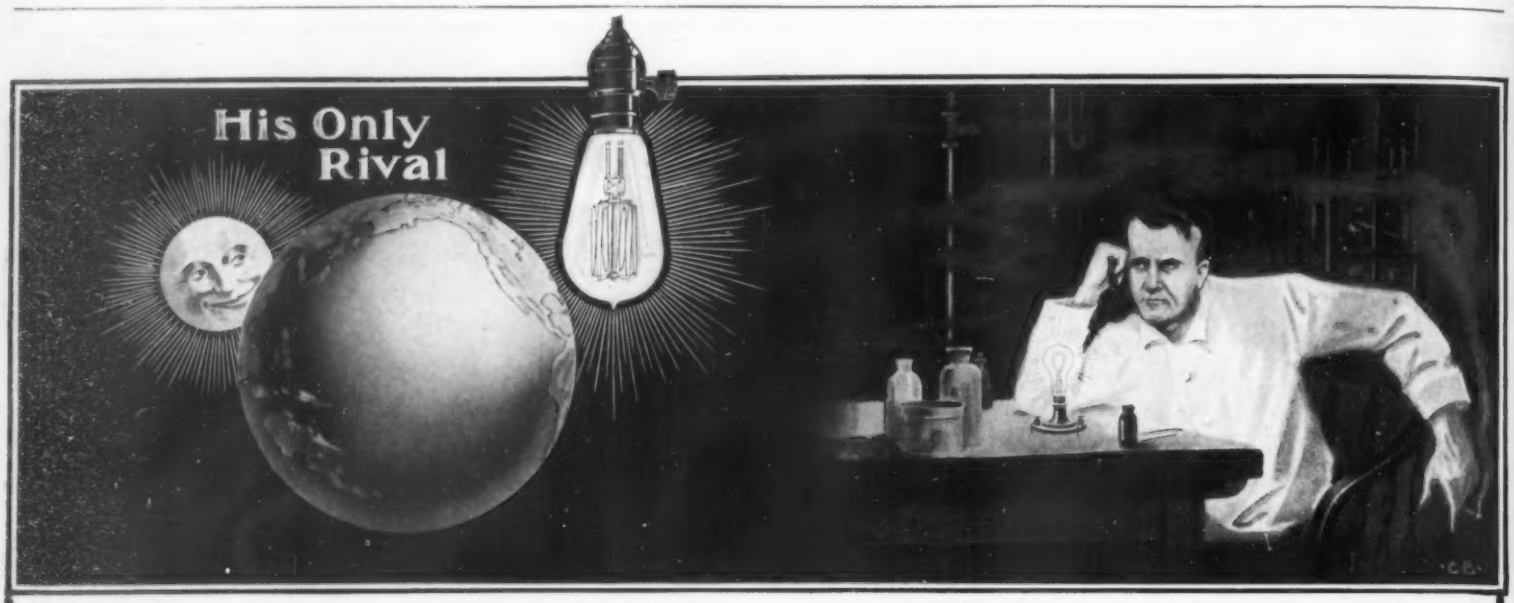


Thirty-two years ago the Wizard of Menlo Park dreamed his great dream which has now come true—Electric Light for Everybody.

Edison's Dream Comes True

When Edison invented the electric incandescent lamp thousands journeyed to Menlo Park to see "the light that burned without air."

Edison put a little paper horseshoe filament, that he had carbonized, into a glass bulb and pumped out the air. Next he passed a current of electricity through this horseshoe.

The Dream

As it glowed white hot, lighting up the darkened room, another light glowed in his face, for he saw the revolution that tiny bulb would bring about in the world's sunless hours.

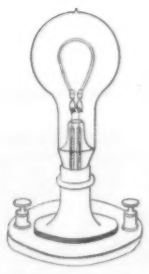
But the first lamps of 16 candlepower used up 100 watts of electricity.

Slowly, as improvements came, the amount of light was increased. Six years ago people thought the limit was reached, for the close of the first quarter-century of Electric lighting was celebrated by the advent of the Edison Gem lamp. Using the same amount of electricity, it gave more than twice the light of that first wonderful lamp.

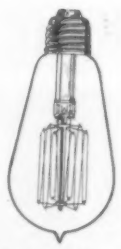
The Revolution

Suddenly another invention in electric lamps revealed the dawn of a new era in electric lighting—unseen in the dreams of anyone—except Edison.

This was the Tungsten filament lamp which—instead of the original 16 candlepower—or the fancied limit of 40 candlepower—gave actually 80 candles of light from the same 100 watts.



Edison's Original Lamp Invented 32 Years Ago



Latest Edison Mazda Lamp with Non-fragile Filament

This lamp almost materialized the Dream—but the filament was brittle—and the cost was high.

Both these obstacles are now cleared away. First, a brilliant invention has resulted in the production of a drawn wire stronger than steel. This wire is used to make the filaments in Edison Mazda lamps.

The filament or "burner" in Edison Mazda lamps is so sturdy that hundreds of thousands are in use under severe and trying conditions, even for lighting railway trains and automobiles.

Next—of prime importance—the full advantage of the General Electric Company's reduced cost of manufacture has been given to the public.

And the present price of the perfected Edison Mazda lamp is about one-half that of the first, brittle tungsten lamp.

The Dream Comes True

So, with lower cost and a better lamp, Edison's dream of the Sun's Only Rival has come true. The waiting millions can be served now that electric light costs so little and does so much.

Now, you can have Electric Light in your home, your office, your store, your factory—at a price you have been waiting for, if you use the latest invention—Edison Mazda Lamps, made only by the General Electric Company.

Buy these Lamps and see how Edison's Dream has come true for you.

Sold by Electric Light Companies and Dealers everywhere.

General Electric Company

Main Lamp Sales Office: Harrison, N. J.

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Chattanooga, Tenn.
Chicago, Ill.
Cincinnati, Ohio
Cleveland, Ohio
Columbus, Ohio
Denver, Colo.
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Minneapolis, Minn.
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New Orleans, La.
New York, N. Y.
Philadelphia, Pa.
Pittsburgh, Pa.
Portland, Ore.
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3162

SIXTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CV. NUMBER 12. ★ NEW YORK, SEPTEMBER 16, 1911 ★ [10 CENTS A COPY $3.00 A YEAR

Courtesy *Metallurgical and Chemical Engineering.*

Charging an electric furnace with molten metal.

Electric steel furnace tipped to pour out its charge.

How Electricity is Aiding the Chemist

Some Principles Underlying the Application of Electricity to Chemistry

By Prof. William H. Walker, Massachusetts Institute of Technology

RAW material and energy, these are the two essential factors which go to make up every industrial chemical process. With the exception of the rare gases of the atmosphere, every object around us is susceptible of chemical change, and hence available to a greater or less extent as raw material for some chemical process. The possibilities of the chemist are in this direction unlimited. The second factor, energy, was for many years supplied almost exclusively in the form of heat derived from the combustion of some kind of fuel, and thus limited in many ways the chemist's activity. It is only within the last quarter of a century that there has been supplied to the manufacturer in commercial quantities, a new form of energy, namely, electricity. With the development of powerful electric generators harnessed to great sources of water power there has been rendered available a form of energy destined to play an important part in the industrial development of the country. When chemical change is brought about by the application of electric energy, we have an electrochemical process; and the art is called electrochemistry.

It would have little value simply to catalogue the many successful applications of electrochemistry which have been worked out, or to describe the great industrial plants based on electrochemical processes which have grown up in America within the last decade. Rather we will attempt to point out some of the principles underlying the application of electricity to chemical industry, and to give a few examples illustrative of each general class.

Electric Conductance and Decomposition.—When a chemical substance such as common salt or blue vitriol is dissolved in water, it is, for the most part broken up or separated into electrically charged atoms or groups of atoms called ions. When a current of electricity from some external source is led into such a solution, it is transported through the solution by these ions. At the points where the current enters and leaves the solution (i. e., the electrodes) these ions are deposited and take from the current the electrical energy necessary to change them into the corresponding elements or compounds. Thus when an electric current is passed through a solution of blue vitriol (copper sulphate) metallic copper separates out where the current leaves the bath, and sulphuric acid is formed at the other, or entering, electrode. This ability of the electric current to decompose chemical compounds into their constituent parts is called electrolysis, and forms the basis of many important industries.

Electrolysis of Salt.—Common salt, sodium chloride, is one of the cheapest as well as one of the most important of our chemical raw materials. From it through intricate and expensive processes there has been made for centuries the caustic soda and soda ash used in a hundred industries, such as the manufacture of glass, soap and textiles. At the same time from this salt by another complicated process the bleaching powder of commerce was produced. Electrochemistry has changed all this. At present by simply passing a heavy current of electricity through a strong salt solution, caustic soda is produced and drawn off at one electrode, and chlorine gas, which when absorbed by common lime makes bleaching powder, is evolved at the other. Compared with the older processes, this electrolytic one is simplicity itself. Although there are many millions of dollars invested in the old processes, the time is rapidly coming when they must give way to the new.

In a very similar way, namely, by passing a current of electricity through a hot solution of potassium chloride (the "muriate" of commerce) and allowing the two products formed at the electrodes to react on each other, is formed the potassium chlorate used in such large quantities in making all kinds of matches. This electrolytic process is carried on at a number of places in the United States and has entirely superseded the old method of making this important chemical.

Refining of Metals.—On this same principle depends the enormously important industry of the electrolytic refining of copper, by which during last year alone something over $100,000,000 worth of pure copper was prepared for the market, besides the recovery of several millions dollars' worth of silver and gold from the waste. The crude or raw copper is cast into slabs which are made the entering electrode (anode) for a heavy electric current passing through a copper sulphate solution. Pure copper is deposited from the copper sulphate solution on a very thin sheet of pure copper which forms the outgoing electrode (cathode), while the sulphuric acid set free dissolves from the crude copper electrode an amount of metallic copper equivalent to the pure copper deposited upon the cathode. The supply of copper sulphate solution is thus kept constant. By maintaining the conditions within certain limits the current is selective in its action, transporting only the pure copper from the crude slab or ingot over to the other electrode where it appears as chemically pure metal. Similar methods are used for refining other metals such as silver, etc.

Metal Plating.—All electro-plating is done by the use of the electric method just described. If we imagine the impure metal anode replaced by a pure metal one, be it of copper, nickel, silver or gold, and the cathode sheet replaced by the object to be electro-plated, we have reproduced a plating bath. Objects of great size such as tubing and conduit pipes are now covered with zinc in this way. Electrotyping is but a variation of the same process.

Metallic Aluminium and Sodium.—Certain molten compounds have the property of conducting the electric current and of breading up at the electrodes just as salts in water solution do. Of special importance in this connection and depending upon this fact is the preparation of the metals sodium, magnesium and aluminium. When a current is passed through molten caustic soda for example this compound is broken up, the metallic sodium separating at the cathode and the remainder of the molecule, oxygen and water vapor, passing out into the air. The molten sodium is cast into ingots and preserved under petroleum oil. It is of great use to the chemist and is now made at about one-fourth the cost of what it could formerly be produced for by strictly chemical means.

But of much greater importance is the manufacture of aluminium, a metal more abundant than iron, and especially noted for its lightness and silver-like appearance. For many years chemists had searched for a cheap method for producing aluminium inasmuch as it is more abundant on the earth's surface than any other metal, and although the price had been reduced from five dollars per pound it could not be made by chemical

(Continued on page 255.)

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Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The Coming International Congress of Applied Chemistry

AT the time of the Columbian Exposition at Chicago in 1893, two hundred chemists of various nationalities convened at the invitation of the American Chemical Society and the World's Congress Auxiliary. So successful was this meeting that it was decided to establish a triennial international congress. Accordingly, the following year the first International Congress of Applied Chemistry was held in Brussels. Since that time, at intervals of two and three years, the Congress has convened at Paris, Vienna, Paris, Berlin, Rome and London. The Seventh Congress held in London in 1909 was attended by four thousand one hundred members; 985 papers were presented, and the final report of the Congress occupied over four thousand pages in print. The Eighth International Congress is to be held in this country next year, the opening meeting being in Washington, while the Congress proper will hold sessions in New York.

The outcome of these international meetings has been to establish uniform standards and to solve many problems of international importance. At the last Congress thirteen topics were proposed to be reported upon at the next Congress. Some of these questions relate to the unification of methods of food analysis; the unification of terms for reporting analytical results of soils, fertilizers, and ash; the establishment of a central bureau for fermentation organisms; the question of securing greater uniformity in the commercial supplies of potent drugs; the conservation of natural resources, etc.

Probably the report on the international patent question will be of greatest interest because it involves the problem of secrecy versus patents in industrial chemistry. It is hoped that a general discussion of this problem will lead to a closer affiliation of the manufacturer with educational centers. Were the theoretical chemist of the university laboratory permitted to enter the commercial laboratory and plant, incalculable benefits would result. It is so easy in chemical operations to keep a process secret that there has not been much incentive to expose methods under protection of patents. In fact, it would be impossible to secure patent protection on some important processes. As a consequence, our professors of chemistry find it difficult and well nigh impossible to keep abreast of the times as regards commercial practice. The men they teach are not sufficiently prepared to enter the field of commercial activity by reason of the barriers erected by manufacturers in the path of the instructors of chemistry. It is greatly to be hoped that some way may be found of solving this problem, as it would undoubtedly result in raising this nation to a higher plane in the field of chemical activity. In Germany, for instance, many university professors are employed as consulting experts in large chemical works. Thus they are brought into closer touch with practical applications of chemical principles, which accounts in part for Germany's premier position in the field of applied chemistry.

The Eighth Congress will evidently take up matters of interest not only to the chemist, but to the general public as well. To stimulate popular interest, four simplified science lectures will be given by representative men of different nationalities.

The committee in charge of the Congress is now concerned with the formulating of rules to govern the proceedings. A set of twenty-two suggested rules has been published, and an invitation is extended to anyone interested in the matter to criticise the rules before the first of December next. These rules apply particularly to those who are to take an active part in the Congress, and relate chiefly to the presentation and publication of papers. In order to avoid the confusion that has existed before, it is specified that papers must be prepared for this Congress exclusively, and must not be read at any previous meeting, or be published in any periodicals before the Congress convenes, and at no time may a paper be published elsewhere without giving credit to the Congress. The papers must be in the hands of the committee before June 30th, 1912, in order to be published and distributed at the meetings. Altogether the arrangements made by the committee seem to be of a very direct and practical nature, which should contribute largely to the success of the Congress.

Our Consular representatives have been active in stimulating interest among chemists abroad, with very gratifying results. A number of affiliated associations expect to meet with the Congress, and hence, an unusually large gathering is assured. Aside from the direct benefits to chemists, exceptional commercial advantages should be presented by reason of the fact that many leading representatives of foreign manufacturers will attend. The opportunity should not be ignored of advertising the advantages of New York city as a manufacturing distributing center, and thus encouraging the establishment of branch manufacturing plants in and about this neighborhood.

Dr. Albrecht Kossel

DR. ALBRECHT KOSSEL, professor of physiology at the University of Heidelberg, has arrived in our country, on invitation from Johns Hopkins University, to deliver a course of lectures on "The Chemical Constituents and the Physiological Rôle of Proteids." With the fact that Dr. Kossel received the Nobel Prize in medicine for 1910, most of us reach the limit of our information about this very interesting man, although it would seem that a work deserving of such high distinction in the field of medicine should appeal to a large portion of the lay public.

Professor Kossel's work is much more subtle and more far-reaching than producing a new remedy for some old disease, or devising a painless system for administering drugs. His work has to do with discovering the nature of certain groups of atoms that make living cells do the many wonderful things that are so intimately connected with *living*. And it is because we may well hope that as a result of this work we shall be enabled to control the chemical activities of cells that are not behaving normally, that the specialized study of "proteids" is so important for medicine.

The analysis of the living body as far as the "cell" was completed over seventy years ago. Later the kernel of living matter or "nucleus" was the focus of attention as the seat of the "vital" cell activities; and then this was further dissected with the improvement in the mechanical and the chemical technique of microscopic research, so that certain special organs within the nucleus became the objects of much questioning and speculation among biologists. These are the so-called "chromosomes." So far the scientists had to deal with things that *could be seen*. Beyond that point the microscope could not help; in applying the methods that led from the molecule to the atom and then shattered the atom, Professor Kossel was a pioneer. For many years he has been working on the chemistry of the complex substances that are present in cell-nuclei and that seem to have a close relation to the growth of protoplasm. The "nuclein" isolated from cells by Miescher in 1871, turns out to be a whole series of compounds that are characterized by possessing an albumen base and a nucleic acid radicle. These Kossel identified with the "chromatin" substance of the student of cells. On the basis of his work Malfatti and Lillienthal showed why the different cell constituents reacted so differently with anilin dyes, the basic dyes combining with "proteids" in the cell in proportion to the amount of phosphorus present—but the amount of phosphorus meant the amount of nucleic acid.

By very delicate methods of digestion with ferments, acids and alkalies Kossel succeeded in isolating a number of these "nucleins" and even produced one synthetically—not indeed from the "elements," but from such relatively simple compounds that his theory of the constitution of the nucleins is abundantly confirmed. The biological application of his analyses and syntheses is that the nucleins play the leading rôle in the growth of protoplasm inasmuch as the acid portion of the nuclein is capable of combining with itself an indefinite number of albumen molecules, later to split them off again to become a part of the living protoplasm, while the acid portion keeps on assimilating new material. Instead of the chromatin, for example, having a constant composition, the proportion of acid and albumen is constantly changing, according to varying conditions. The work is extremely specialized, but of tremendous importance: it will furnish the raw material for results of great practical importance, as well as of theoretical significance.

The Legend of the Rain-tree

DURING the last few months American newspapers have revived the well-worn tale of the "Peruvian rain-tree," which affords protection against drought. The leaves of this tree are said to have the property of condensing atmospheric moisture in large quantities and precipitating it in the form of rain. According to one writer, "the water falls from the leaves and oozes from the trunk and forms veritable rivers, which can be led as irrigating canals to any point desired. Making liberal allowance for evaporation and infiltration, a square mile grove of the trees would supply for distribution about 100,000 gallons of water daily."

On the strength of similar stories one of the trees to which the name "rain-tree" has been most often applied, viz, *Albizzia* (or *Pithecolobium*) *Saman*, has lately been exploited and sold extensively in Australia. The virtues claimed for it have proved to be altogether illusory, although it is useful as a shade-tree, and is widely planted for this purpose in semi-tropical and tropical countries.

The legend of the "rain-tree" or "raining-tree" dates back to the stories of the Fortunate Isles, where no rain fell from the skies and the soil was refreshed by the moisture shed by a tree of the sort described. The early navigators brought home stories of similar trees in the East Indies, in Guinea, Brazil, etc. The Peruvian rain-tree appears to have been brought to the notice of the world by the reports of a United States consul in Peru, about 1877. These reports were widely quoted at the time, and led the government of India to seek information on the subject from the authorities of Kew Gardens. The investigations of W. T. Thistleton Dyer brought to light a plausible explanation of at least a part of the rain-tree stories.

The traveler Spruce reported his own experiences with the rain-tree as follows:

"The Tamia-caspi, or rain-tree of the eastern Peruvian Andes, is not a myth, but a fact, although not exactly in the way popular rumor has lately presented it. I first witnessed the phenomenon in September, 1855, when residing at Tarapoto. I had gone one morning at daybreak, with two assistants, into the adjacent wooded hills to botanize. A little after seven o'clock we came under a lowish spreading tree, from which with a perfectly clear sky overhead a smart rain was falling. A glance upward showed a multitude of cicadas sucking the juices of the tender young branches and leaves, and squirting forth slender streams of limpid fluid."

This is not the only explanation. That many plants spontaneously exude moisture under suitable conditions is well known. The phenomenon is called "guttation," and has perhaps been most fully described by A. Burgerstein in his work "Die Transpiration der Pflanzen" (Jena, 1904). The moisture drawn up from the roots of plants most frequently passes off into the air in a gaseous form; i. e., by transpiration. If the air is saturated with moisture, and if the supply of moisture to the roots is copious, then liquid drops will be exuded sometimes in large quantities. Molisch records a case in which a single leaf of a species of *Colocasia* gave off 190 drops per minute. Burgerstein gives a list of 241 plants, belonging to 101 families, in which guttation has been observed.

This process goes on chiefly at night, and in cloudy and foggy weather; i.e., when the relative humidity of the air is highest. It is altogether probable that in the moister parts of the tropics there are trees which exhibit this phenomenon in such a degree that the name "rain-tree" may be fittingly applied to them. It is, however, certain that no such process can occur in a dry climate, and that the proposal to plant the rain-tree as a panacea against drought is entirely chimerical.

Artificial Rubber

Another of Nature's Laboratory Secrets Unmasked

By Ira Remsen, President of Johns Hopkins University

ABOUT forty years ago two young chemists announced that they had succeeded in making enough indigo to be pretty sure they had it. The method used by them was entirely independent of the indigo plants. The yield was extremely small and there seemed to be no promise in the method of future commercial success. A quarter of a century later or thereabout the manufacturer was supplying the world with artificial indigo and the occupation of the indigo planter, if not gone, was going. And now the chemical world is all agog over rubber. Last year a specimen of artificial rubber was exhibited at Berlin identical in all its properties with the natural substance. At present there appears, to be sure, to be little prospect of early commercial success along the line suggested, but the results already reached are of such interest as to incite to many efforts to solve the problem.

First a few words concerning rubber. This substance is obtained mainly from South and Central America, though, of late years, owing to the great increase in the demand for it, plantations have been started, especially in Ceylon and the Malay Peninsula and Archipelago, and these are now contributing to the world's supply. In 1909 the production of rubber is stated to have been 70,000 tons. It is obtained from various trees as *Hevea brasiliensis*, *Manihat Glaziovii*, *Castilloa elastica*, *Funtumia elastica*, *Ficus elastica*, *Hancornia speciosa*, etc. Deep incisions are made near the base of the tree. The liquid flowing from these incisions is heated to drive off most of the water and the residue is the impure rubber of the market. The valuable constituent is caoutchouc, a colorless, elastic, amorphous substance. This has long been known but little has been learned in regard to its chemical nature until recently.

In general terms it may be stated that chemists do not like to work with gummy substances, but prefer things that crystallize, or that boil without decomposition, or that form definite crystallizable products. Now caoutchouc does not crystallize, it does not boil without decomposition, and until a few years ago it was not known to be capable of yielding definite crystallizable products. Great impetus was given to its study by the discovery of Harries that it forms a well-defined product when treated with ozone, and that the ozonide thus obtained decomposes when boiled with water and yields levulinic aldehyde, a substance that can easily be identified.

It has also been shown that caoutchouc forms a so-called nitrosite when treated with nitrous acid, and this nitrosite can also easily be identified. These facts make it possible for the chemist to tell whether he has caoutchouc in hand or not and the scientific study of the substance has been materially advanced in consequence. Before the discovery of these facts a product had been obtained artificially that was described as "like rubber," but the question whether it was identical with caoutchouc or not could not be definitely answered. Now it is possible to determine with certainty whether a substance is or is not caoutchouc.

To identify caoutchouc after you get it is one thing, to determine what it is is quite another. The first step towards the solution of this problem was taken a number of years ago when Greville Williams showed that when rubber is heated to decomposition a very volatile substance is formed which he called "isoprene." This boils at 36 deg. C. and is a hydrocarbon of the formula C_5H_8. Later Harries found that this same hydrocarbon is formed by the action of moderate heat upon oil of turpentine and other terpenes. This isoprene has come to be the chief factor in the artificial preparation of rubber, for it is this substance which when exposed to certain conditions is converted at least partly into caoutchouc.

That isoprene readily undergoes change was observed by Tilden who announced in 1892 that one of the products is caoutchouc. Later he stated that contact with strong acids as, for example, aqueous hydrochloric acid, causes the change of isoprene into caoutchouc, at least to a small extent. Still later he claims to have discovered that isoprene is changed to caoutchouc spontaneously. He says: "Specimens of isoprene were made from several terpenes in the course of my work, and some of them I have preserved. I was surprised a few weeks ago at finding the contents of the bottle containing isoprene from turpentine entirely changed in appearance. In place of a limpid, colorless liquid, the bottle contained a dense syrup in which were floating several large masses of a solid of a yellowish color. Upon examination, this turned out to be India rubber."

Harries tried to repeat Tilden's work, but although he kept at it for seven years he was unable to confirm his results. He says: "Tilden must therefore accidentally have hit upon conditions which caused the polymerization of the isoprene, but, and this is the main point, he did not furnish the proof that he really had produced caoutchouc." Klages had previously publicly stated that it is impossible to produce caoutchouc by the method suggested by Tilden. This was the state of affairs as far as the chemical public was concerned until the summer of 1909. Then Harries received from an English firm a specimen of a substance which it was claimed had been made artificially by a process patented by Dr. Heinemann in England. Harries found that the substance was in fact caoutchouc, but he did not believe that it had been made artificially. Heinemann's method consisted in passing acetylene, ethylene, and methyl chloride together through a tube heated to redness. Harries could not make this work and others who tried it also failed.

Up to this time the experiences of Harries had been anything but encouraging. In November, 1909, he received from the Elberfeld Color Factory some specimens of artificial rubber which had been made from isoprene by a secret process devised by Dr. Fritz Hofmann. This led Harries to take up his own experiments on the subject again, and toward the end of January, 1910, he was in a position to apply for a patent. The method devised by him consists in heating isoprene with strong acetic acid in a closed tube. The product thus obtained is unquestionably caoutchouc.

From the scientific point of view the problem of the artificial preparation of caoutchouc is thus solved, but it is a far cry from this to commercial success. Given isoprene in sufficient quantity and at a sufficiently low price and the commercial problem will be solved. At present artificial rubber is almost as precious as the diamond, but, on the whole, the problem is in a more hopeful state than the indigo problem was for years after the start was made. The manufacturers and those who are carrying on chemical investigations for them are plainly of the opinion that the work is worth while. That great firm, the Baden Aniline and Soda Factory (generally called the "Badische") has taken out a number of patents in this field, and this is most significant. It is this firm that worked out the indigo problem and is now supplying the world with artificial indigo, having expended in the preliminary work millions of dollars! It is this firm that is placing the manufacture of artificial nitrates upon a firm scientific basis—probably the most important problem before the world as it involves ultimately the food supply. It may safely be predicted that before many years have passed rubber will be artificially prepared in quantity sufficient to supply the great and increasing demand for it. Meantime there is no danger of a famine as plantations are springing up to supplement the supply of wild rubber.

As has been pointed out the first thing to be done is to get enough cheap isoprene. The only way to do this that appears to be in the least promising is to make it from oil of turpentine. The chief constituent of this oil is a terpene of the composition $C_{10}H_{16}$, while isoprene has the composition C_5H_8. The immediate problem, therefore, is to break down the molecule of the terpene, $C_{10}H_{16}$, into simpler molecules of the composition, C_5H_8. If this could be done easily and cheaply the rubber problem would be solved. In this connection it is of interest to note that, according to an article that has just come to hand, Staudinger and Kleven have succeeded in increasing the yield of isoprene obtained from the terpene, dipentene, by heating to a high temperature the vapor of the terpene under diminished pressure. When the pressure is sufficiently low the yield is about 60 per cent. This is a very important observation for the purpose in view. Dipentene itself does not, to be sure, occur in nature in very large quantity, but the chief constituent of American oil of turpentine is pinene, a substance of the same composition as dipentene, and pinene is converted into dipentene by heating it to 250 to 270 deg. C. The way out may therefore be through turpentine. To recapitulate, turpentine contains pinene. Pinene is converted into dipentene by moderate heat. Dipentene when heated to a high temperature under diminished pressure yields isoprene. Isoprene can be converted into caoutchouc by heating it with concentrated acetic acid and by other methods that need not be described here.

There are other hydrocarbons similar to isoprene that undergo changes similar to that by which isoprene is converted into caoutchouc, and there is therefore a prospect of the ultimate preparation of a number of products similar to rubber but differing from it in some respects. The commercial instinct has already led to the patenting of some of the processes involved. This aspect of the subject is, however, or it appears to be, of much less importance than the main problem briefly presented in this article.

In the chemical laboratories connected with the great factories, especially in Germany, where several hundred well trained chemists are frequently engaged in a single factory, no doubt much work is now in progress which has for its object the solution of the artificial rubber problem. This is also true of laboratories not connected with the factories. From time to time an article will appear in a scientific journal or a patent will be announced giving some result of the work. As usual, of the failures and disappointments, which always far outnumber the successes, we shall hear very little. But some day we shall wake up to learn that artificial rubber is on the market and then we shall be told truly that scientific research has scored another brilliant success. In the eyes of the world success will mean commercial success. But it must not be forgotten that this, if and when attained, will be based upon innumerable results that have absolutely no commercial significance. Greville Williams heated rubber and obtained isoprene many years ago. No one dreamed at the time that this simple fact might ultimately become the basis of a great industry. Harries treated caoutchouc with ozone and founded a method for indentifying caoutchouc which has proved of fundamental value in all subsequent work on this subject. We want to know what caoutchouc is, whether any one ever devises a method for making it artificially or not, and in the highest sense the knowledge will be just as valuable whether such a method results or not. But that is another story.

Arrangement of Laboratory Supplies

By William P. Munger

IN an industrial laboratory, containing some 1,500 bottles of chemicals, it is no small job to keep even the chemicals in order. The helpers upon whom the restoration of the bottles to their places devolves usually have little skill and less interest in things chemical. When the chemicals are arranged by the usual alphabetic method, reagents are mostly found, and only then after prolonged search in just the place they ought not to be. Owing to the vast difference in size of bottles, to get any efficiency out of shelf space, it is necessary to have at least two or three alphabets, and when the search is completed through one, the others must be searched.

To overcome these obstacles to speedy work, the following system was recently worked out in one industrial laboratory: The contents were first roughly grouped as to size, and then as to nature of contents. Beginning on the upper and lower shelves, the containers were placed in rows from front to back. The upper left row was numbered 0-9, the second row 10-19, the third row 20-29, etc. The last figure on the front bottle always being 0, and if the shelf did not accommodate 10 bottles from front to rear then the numbers corresponding to the missing bottles were omitted, the next row beginning with the next higher ten. An alphabetical and numerical index was then compiled, giving a little description of the chemical in each bottle (such as C. P. Sticks, commercial powder) and typewritten copies made.

When a given chemical is wanted, a reference to the index is essential, but a glance shows what form it is in, and the bottle of that chemical best suited to the work in hand can be at once selected. Further, if a helper, although it may be his first day in the laboratory, is sent after a reagent, and given a number, readily found, instead of an unfamiliar chemical name, the chances are greatly improved of his bringing back what was desired. When the reagents are to be replaced they are much more readily replaced in their correct positions by this method, even by skilled workers.

This method is of wide applicability to medium sized stocks of articles, varying in size and use but not in name, such as motor and meter parts, construction material, switches, insulators, patterns, etc.

Testing tensile strength of steel on a 100,000-pound machine.

Testing Before Buying

The Economics and Aesthetics of Materials

By Dr. Charles F. McKenna

A corner of a private paper-testing laboratory.

THE simplicity and directness of aim observed in the choice of materials in the old arts and crafts have always elicited the admiration of thoughtful men and the wonder of curious ones. Consider, for example, how animal glue so happily answers the needs of the joiner for uniting two pieces of wood; how easily it can be treated and how perfectly it shows both tenacity and adhesion. This valuable and complex substance was known to the Egyptians, and they are said to have left on record descriptions of how to prepare it of best quality.

As to the metals, we can understand that the ancient artificers, once they became acquainted with the different ones, perhaps by accidental smelting, should avail themselves of such obviously valuable aids; thus also of wood and of stone for building materials; but there are many other substances whereof the choice is remarkably discerning and apt, strongly suggesting that it was preceded by much patient investigation and keen observation.

Was it some clay worker making bricks for building who discovered that soft clay might be written upon and then burned as tiles to make imperishable historical records? Who first observed the silk worm and learned how to unwind the cocoon, strengthen the thread and weave cloth from it to make the garments of the rich? The ancients knew how to mat wool fibers together and make felt. They must have understood that the character of the surface of this fiber is unlike that of others and why it makes felting. Those ancient craftsmen evidently possessed a spirit which was eager for research and experiment and which overcame many difficulties of isolation and poverty.

Modern times can point to triumphs of its technologists in the similar search for suitable material to apply in the arts. But the needs now are broader by the very fact of our greater resources to draw from and our vastly larger fields of activities. It becomes necessary for us to develop a much greater devotion to research into the properties and adaptations of materials. We cannot be contented with our present knowledge. We must have a larger variety of materials than we are yet acquainted with if we are to advance in the arts of construction, transportation, agriculture and manufactures. We need also a better acquaintance with those we have if we are to use them to best advantage and equal the older craftsmen in aptness of choice.

The uncovering of a new product or the application of newly discovered properties of an old one has possibilities for adding to the wealth of nations which can hardly be estimated.

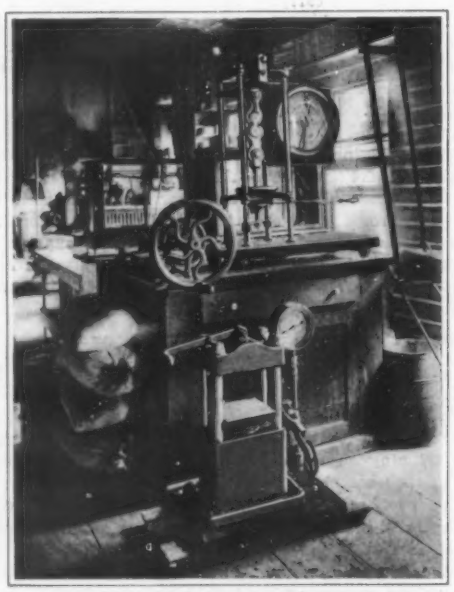
The extraction of oil from cotton seed, an industry which did not exist before the civil war, has now reached a production valued at one hundred million dollars annually.

The virtue that lies in carefully selecting and compounding cement materials before calcining them at a high heat rather than taking them at random and burning at low temperatures has, in twenty years lapse of time, given us the Portland cement industry totaling seventy million dollars annually, and has almost extinguished the natural cement industry which produced not more than a twentieth of this in its best year.

The industry of manufacturing dynamite has grown till more than fifteen million dollars worth are manufactured annually. What will be the corresponding value when this powerful agency has been made safer by the lowering of the freezing point of nitroglycerin and by other stabilizing improvements and shall be introduced into agriculture for the breaking up of subsoil, clearing of forests, and draining of swamps?

Lastly, we must exercise a control over all materials we purchase, examining them critically both to determine suitability and to appraise the market value. Engineering, which now involves so much more than was meant by the term a generation ago, is more concerned than ever over the qualities of materials which are offered to it. In attempting to determine these it finds itself in need of resorting to instrumental means of manifesting differences in properties in order that fallible human judgment may be eliminated as much as possible. The movement began by demands for the preparation and preservation for duplication of the standards of weight and measure. Railway engineering was insistently calling for a deeper study of iron and steel. This resulted in a most intimate investigation of the chemical constitution of steel and brought about at the same time the development of machines and apparatus for observing almost all the physical qualities of materials. Later years have brought us demands of the same nature, not only from the constructional arts, but also from every branch of manufacturing. The practice of the art of testing now includes the chemical, physical and mechanical studies of all kinds of iron, steel, copper, alloys, stone, cement, clay, coals, paper, paint, rubber, wood, textiles and a host of materials used in technology.

Determining the heat value of fuel.



The machine on the table was used in testing much of the cement used in the Brooklyn Bridge towers. In the foreground is a portable hydraulic cement-testing machine.

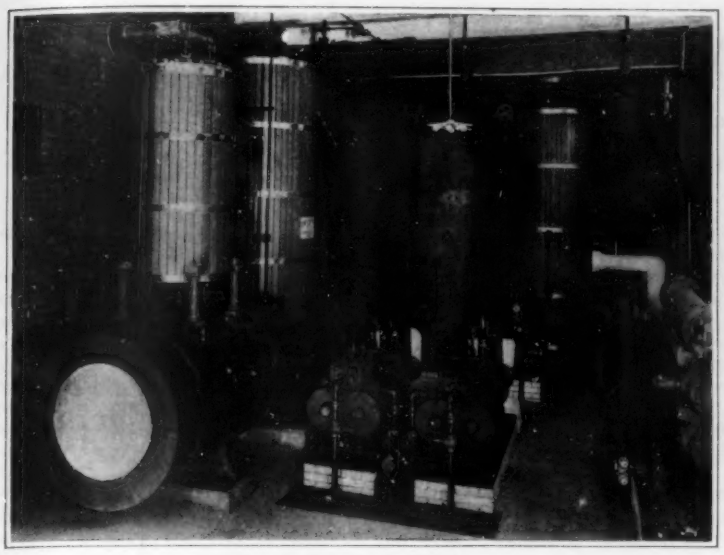
Out of this has grown a larger development of the governmental agencies which were established only as repositories of the standards of measures such as was originally the case with the Conservatoire des Arts et Metiers in Paris. Many nations endowed scientific stations for the applications of precision measurements. The Imperial Physical Technical Institute of Charlottenberg, near Berlin, is one of these, and is the most important and valuable standardizing laboratory in the world. It is composed of two departments, one dealing with the standards of measurement and obtaining correct data as to physical forces; the other dealing with determinations of the accuracy of technical instruments submitted for the purpose and to be absorbed in their turn into use as standards in other laboratories. A staff of more than one hundred experts and assistants is entirely supported by the government for this purpose. United with this is the Royal Material Testing Bureau of Gross Lichterfelde, whose object is to apply results of research directly to technical problems and routine testing of materials. It has the following departments: 1, metal testing; 2, building material testing; 3, paper and textile testing; 4, metallography; 5, general chemistry; 6, oil testing. It employs over two hundred persons and makes many thousand tests annually in these departments. Thus the co-relation of research and technical interpretation can be adjusted nicely under the guidance of the most skilled and patient investigators that the realm affords. France, Austria and England have institutions of like aim.

We are now abreast of the world in this important application of science, for our Bureau of Standards in Washington, founded by Act of Congress of 1901, has been operating for several years under the able direction of Dr. S. W. Stratton, and has made many valuable contributions to the literature of the science of exact measurement. Congress has continued to provide generously for the maintenance and extension of this work. Regarding the value of the chemical departments of the bureau, Dr. Stratton has said: "The relation of the chemical work to that of the other sections of the bureau is exceedingly important. Scarcely a problem can be taken up concerning construction or the properties of materials that does not involve chemical analyses or the co-operation and advice of expert chemists. The entire work of the bureau has been greatly strengthened and its efficiency increased by the organization of the work in chemistry."

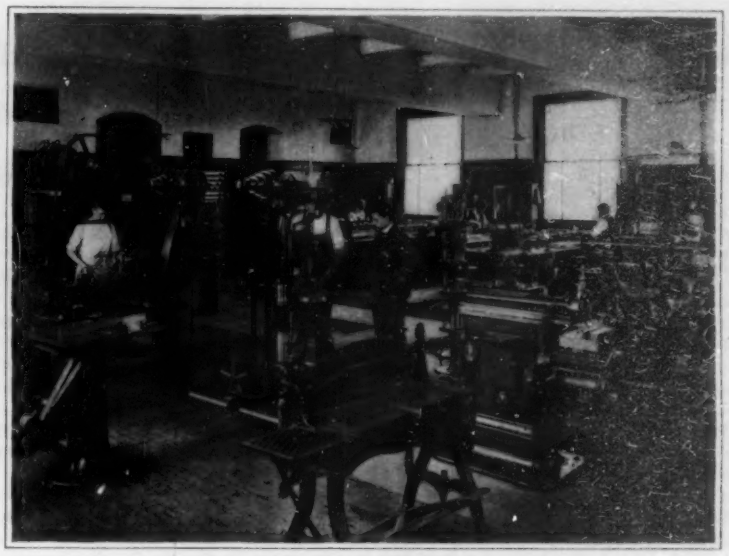
A new section has been organized to provide for the routine testing required by the departments in making their purchases of supplies.

Perhaps the most prominent organization under one head availing itself of chemical examination and testing of all its supplies is the Isthmian Canal Commission, since its work constitutes the largest piece of construction and the largest housekeeping proposition that have ever been combined. As this calls for an expenditure of $300,000,000 within a decade, it can be seen that the supplies of materials are an important factor and demand close scrutiny.

These methods are applied by the Commission and the Purchasing Agents' office is concerned over the quality of the bronze wire bought for mosquito screens just as it is over the Portland cement which will be required for the dams and locks. It wants to know the composition and strength of the steel used in construction, the Babbitt metal used in engine bearings, the dynamite used in blasting, and so on through a thousand things as diverse. This is on the very correct theory that the United States should get full value for everything it purchases, small or large.



Part of the refrigerating plant.



Shop for making and repairing instruments.

Besides these government laboratories there are many others in this country which practice chemical and physical testing of materials for determining their qualities and values. Some of the largest of them are operated by the railroad companies, and quite a number by the great manufacturing corporations. In the latter case some concern themselves only with their own product, some with all the materials they purchase, and some have departments adapted solely to research into the properties of materials, applying the results to their factory practise.

In all the large centers of population and manufacturing are to be found laboratories where the needs of commerce for the testing of materials can be met. The same great variety of substances and fabrics are submitted to the chemists and physicists on their staffs, who are frequently appealed to for the decision of important questions. Yet in the application of material testing to the industries one meets at times a marked indifference to its economic advantages. This is the more curious since there are so many cases where they are obvious and so many where successful manufacturers testify to the importance to them of upholding this arm of efficiency.

They know that in many raw materials entering into the manufacture the presence of an adulterant or an inert substance carries a greater penalty than the mere payment for the useless element. The factory and handling charges accumulate against it just as if it was a valuable element and the output of finished material is reduced.

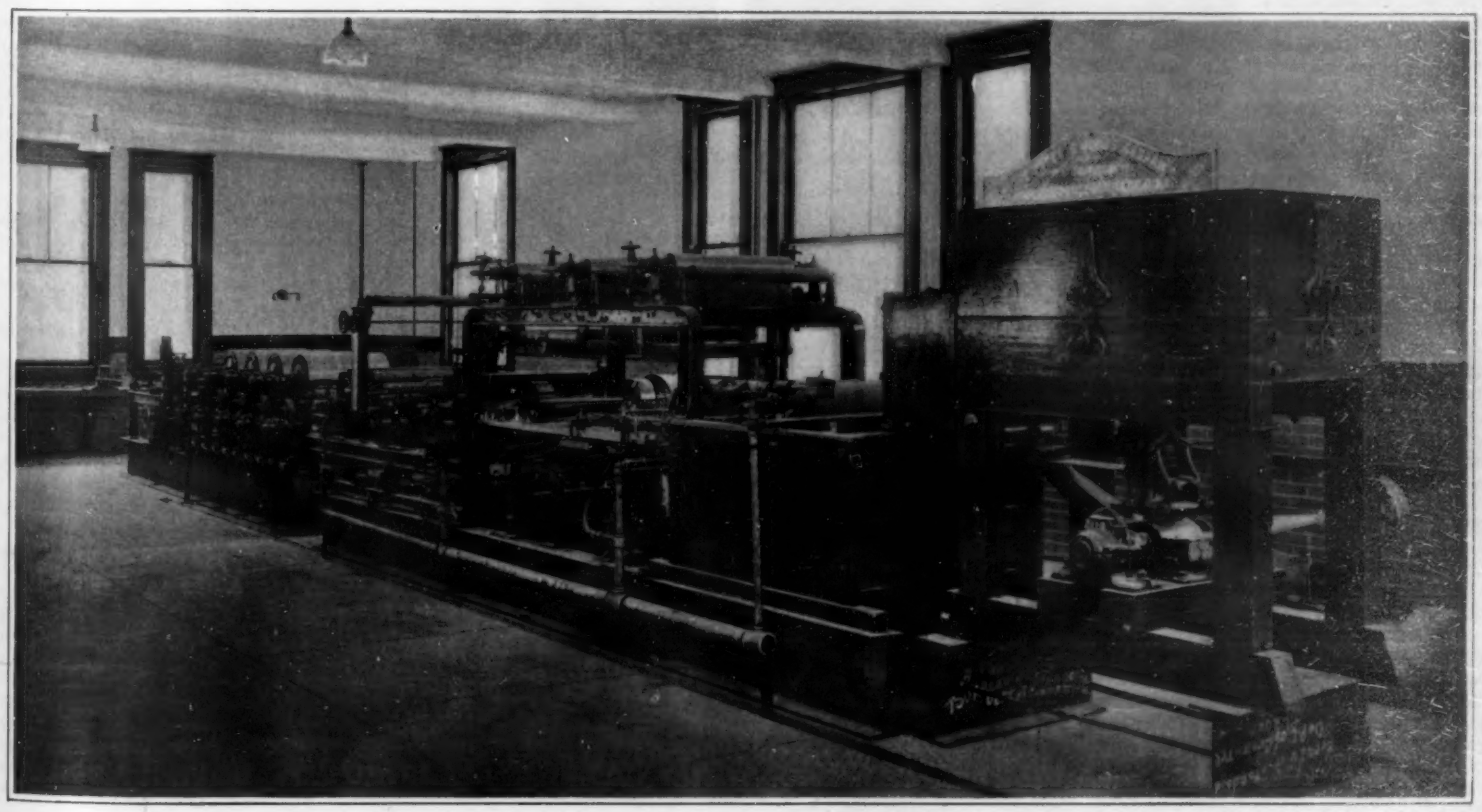
If, for example, one wishes to neutralize acid solutions with lime and employs an impure lime instead of a pure one, he will use more of it and he will be obliged to dispose of more sludge, possibly carrying with it absorbed valuable substances. If one uses a coal whose fuel value, measured in heat units, is less than that of a coal used by a competitor, he will likely feel the difference, not alone in his coal bills, but in his labor items for stoking and for disposal of refuse.

United States standard of mass—kilogramme.

The manufacture of silk fibrics furnishes another example. One would think that any manager using in large quantities as his chief raw material a substance more costly per pound than coal is per ton would be solicitous to keep exact record of the moisture in the lots he would buy that he might know their absolute dry weight, or "conditioned weight," so called.

Yet in the case of raw silk as used in this country we see something remarkable. 20,363,327 pounds, worth $65,424,784, were imported into this country in 1909-1910. Special trains flew across the continent at high speed to bring the Japanese importations from San Francisco to New York city. So valuable was this raw material that a gain in interest and insurance was made by this haste. Yet only 1,298,709 pounds were officially "conditioned" for moisture or examined for other non-silk substances at the silk association's laboratory in New York city during the same period. Of course some silk manufacturers have their own silk conditioning laboratories, but they are very few. Moreover, these figures are confronted with the statistics of conditioning in Europe whose consumption of raw silk is rapidly being approached by that of America. In the Milan conditioning house in

(Continued on page 260.)



Special experimental paper machines for the materials testing laboratory.

SOME VIEWS OF MACHINERY USED IN THE LABORATORIES OF THE U. S. BUREAU OF STANDARDS

Catalysis

Its Mystery and Its Significance for Life and Industry

By Alfred J. Lotka

CATALYSIS or catalytic action has been somewhat variously defined. To give a rigid definition in simple terms is difficult, or perhaps impossible, and it is therefore preferable in an article of this kind to describe the phenomenon, rather than to attempt to define it.

It is, for various reasons, advisable to follow Ostwald in grouping together under the general heading of Catalysis two types of action, which perhaps at first sight may not appear very closely related, and which we may speak of as physical and chemical catalysis respectively. The feature which is common to both is that they occur in unstable (technically "metastable") systems. One or two examples will make this plain. By carefully observing certain precautions, water may be cooled below 0 deg. C. (32 deg. F.) without solidifying. In this state the system is unstable. Introduce a minute crystal of ice, and immediately a growth of this solid phase spreads out from the crystal "germ," with which the water has been "inoculated." This effect of the ice crystal in bringing about the change from water to ice is an example of what was spoken of above as physical catalysis. Instances of this kind might be multiplied, but one will suffice for our needs. The facts which we want to notice, as being particularly characteristic of this "catalytic" action exerted by the "germ" introduced are:

1. The amount of water which can be caused to solidify by the introduction of the ice crystal stands in no relation to the size of the crystal. A given small crystal is capable, under suitable circumstances, of causing the freezing of an unlimited quantity of water.

2. The result that can be produced by the "germ" is absolutely limited to the establishment of the stabler (frozen) condition, from the less stable (liquid) state. The ice crystal would be quite incapable of producing, under the stated conditions, the opposite change, namely, the melting of the ice. This might be expressed in popular language by saying, that what the catalyser does, is merely to help on a change which is "trying" to take place also in its absence.

We shall have a few more words to say of physical catalysis further on, but what has been said so far may serve as a basis which will enable us better to appreciate the nature of "chemical" catalys's. It is a matter of very common observation, that a chemical reaction which proceeds with difficulty or (seemingly) not at all on merely bringing together the substances consumed in the transformation, takes place with greater or less ease—sometimes tumultuously—as soon as a small quantity of some suitable material is added. This itself appears to take no part in the transformation. Judging from the fact that it can be recovered unchanged from the resulting products of the action. This chemical catalysis, as the effect is called, presents the same peculiarities which we noted above with regard to physical catalysis:

1. A small amount of the catalyzer is capable of causing the chemical transformation of an indefinitely large amount of material (though in practice there is necessarily some loss of the catalyzer through various secondary causes, such as the impossibility of completely separating it from the product).

2. The action of the catalyzer is strictly limited to the establishment of a "stabler" condition from a "less stable," or, in other words, a catalyzer can only produce or encourage such a [net][1] reaction, as brings the reacting system nearer to its equilibrium, and never, under any circumstances, the reverse. In the case of a chemical reaction we may deduce from this second rule a third. For we may state the second rule in this form: "A catalyzer is powerless to alter the equilibrium of a chemical reaction."[2] Since a chemical equilibrium is a condition in which two opposing reactions are going on at the same velocity, it follows immediately that:

3. If a catalyzer accelerates one of a pair of equilibrium reactions, it must accelerate the other in exactly the same proportion.

These, then, are the fundamental facts relating to catalysis. It is very natural to ask: "How — by what mechanism — does the catalyzer exert its effect?" To this question we can give at best but a very imperfect answer. We shall do well to be guided in our attempt by keeping constantly before our mind's eye the fundamental facts related above. A mechanical model will best serve to illustrate the nature of the case. We may liken the supercooled water — ready at any instant to freeze on introduction of an ice crystal — or the mixture of $SO_2 + O$ — ready to unite (say at 500 deg. C.) to SO_3 as soon as it comes in contact with finely-divided platinum — to a liquid contained in a bowl at an elevated level. Popularly speaking, the liquid is "trying" to flow to a lower level, and will in fact do so as soon as *a suitable path* is furnished, either by making a hole through the side of the vessel, or by carrying a syphon over the edge of the bowl. Once we have done the small amount of work required to start the flow, we can derive an unlimited amount of energy from the outflowing liquid, since the bowl may have any dimensions whatever without affecting our argument. What prevents the liquid from flowing down from the bowl, is that before it can descend it must ascend, or, in technical terms, in order to pass from a point of higher potential to one of lower, it would have to travel over a path passing through points of still higher potential than the starting point. This would be contrary to the physical laws applicable to the case under consideration.

In the same way we may suppose, that the molecules of SO_2 and O are tending to unite to form molecules of SO_3; all but a small proportion of them however are prevented from so doing by the fact that, in the course of the change, they would have to pass through intermediate states "on the crest of the hill," before they could take their downward path to the more stable condition.

When we come to consider the exact manner in which the catalyzer furnishes this new path, we find ourselves in difficulties. In some cases at least a partial explanation can be given. For example, if the reaction takes place between gases, as in the case $SO_2 + O \rightarrow SO_3$, the action of a finely-divided material, such as spongy platinum, may perhaps be accounted for by the fact that gases tend to form a fine film of greater concentration near the surface of a solid. Such increased concentration might explain an increased reaction velocity. In other cases it has been shown that in the presence of the catalyzer the reaction takes place in two stages, each stage singly being more rapid than the net reaction in the absence of the catalyzer. But these are at best partial explanations, applicable to isolated instances of a phenomenon which is extremely common, and indeed, probably universal. The cause of the mystery which still enshrouds catalytic action is not far to seek. It is closely connected with the fact that our knowledge of chemical action is almost wholly restricted to the initial and final states. Of the processes which intervene between the instant when a molecule of one compound ceases to exist as such, and the moment when the molecule of the product is completely formed, of these processes we know practically nothing. Referring to this subject, Schönbein[3] has remarked: "Shakespeare says that 'there are more things in heaven and earth than are dreamt of in philosophy.' Thus, presumably, intermediate between the state in which two portions of matter exist after completion of chemical combination, and the state in which they previously existed separately, there is a series of transition states of which the chemistry of to-day knows nothing." With all the advances which chemistry has made since Schönbein wrote these words, they still remain true almost to the letter.[4] So long as we are left in our present ignorance of those states of matter which intervene between the initial and final states in "chemical change," it is very unlikely that we shall be able to form an adequate idea of the nature and inner meaning of catalysis.

The current is turned off, and dense acid fumes issue from the apparatus.

On establishing the electric field, there is practically perfect condensation of the fumes.

By courtesy of *The Journal of Industrial Chemistry.*

CONDENSING ACID MIST BY ELECTRICITY

So much for the facts and theories of catalysis. Now for its bearing upon technical and vital processes.

From a theoretical point of view it is a somewhat disputed question whether a catalyzer can start a reaction, the German chemist Ostwald holding that it can merely accelerate a reaction, which would go on, however slowly, in its absence also. For practical purposes, this fine distinction is of no interest, for a reaction which took thousands of years to become noticeable would be quite worthless and might as well be said not to take place at all. Generally speaking, the function of a catalyzer in technical practice is not only to speed up a reaction, but to render it industrially possible at all. Nevertheless, it may be interesting briefly to consider the economic effect of catalytic *acceleration* upon the process. Suppose that under given conditions one ton of raw material and material in the course of transformation must be locked up in the process, in order to produce a daily output of, say, one ton of the product. With all other conditions unchanged, let us now suppose that by the introduction of a suitable catalyzer the reaction velocities are just doubled. If we require an output of one ton, as before, we can now reduce our plant in the

(*Continued on page 260.*)

[1] By "net" reaction is here meant the resultant of two opposing reactions, in case we have to deal with a "reversible" reaction.

[2] This does not apply to "stationary states" such as occur in certain light reactions. They are not true equilibria.

[3] *Journal f. prakt. Chemie*, volume 55, 1. 152.

[4] We may, perhaps, however hope for new light on these questions from the recent work of Max Trautz.

The Industrial Chemist

What Opportunities for Achievement are Offered Him

By Robert Kennedy Duncan, Professor of Industrial Chemistry at the Universities of Pittsburgh and Kansas

So many men, and the parents of so many men, who are interested in modern science read the SCIENTIFIC AMERICAN that one is tempted to take the opportunity of this special number on Industrial Chemistry for some intimate discussion on the invitation which this science extends. What is Industrial Chemistry, how may one become an industrial chemist, and what opportunities for achievement does it offer? The writer is prompted to this because in his positional capacity he is this year at the receipt of an unprecedented and altogether un-looked-for number of inquiries and personal visits from men and their parents who are just as ignorant of this matter as they are interested. These inquiries arise through the vague, but entirely valid, idea that there are some remarkable contemporary opportunities in Industrial Chemistry.

Leaving for the nonce the nature and scope of these opportunities, let us settle the meaning of the term—What is an industrial chemist? The fact is that "the industrial chemist" and the training he ought to have, is to-day a subject of warm debate among those of us who follow applied chemistry. As is usual in such discussions, the trouble-factor lies in our varying definitions. To one man, an industrial chemist is a chemical engineer, to another, he is a "works chemist," to a third, he is a routine analyst, to a fourth, a scientific researcher, and so on. There are thus many types of industrial chemistry, and many kinds of each type and each kind with its own allure. Industrial Chemists are all alike in this, however, that they are interested in applying chemical knowledge to practical and useful ends. The industrial measure of what is practical and useful is the dollar, and the only material difference between Pure Chemistry and Industrial Chemistry is that with the Industrial Chemist the dollar sign inevitably enters into every chemical equation; a subordinate difference is that many industrial chemical reactions are carried out by the ton instead of by the gramme.

How, then, is one to become an industrial chemist? Obviously, by learning Chemistry. An industrial chemist may have some knowledge of engineering, or of biology, or, for that matter, of psychology (all the better if he has), but the *sine qua non* is Chemistry. Chemistry is Chemistry; and since it is *quite* impossible to obtain it self-taught, the novice must enter some institution of learning for the requisite training. It is just at this point that he needs guidance.

If the young man is too old to undergo the school-training that would enable him to matriculate into one of the higher institutions of learning, if he has responsibilities, such as the support of mother and sisters, that would make it inadmissible for him to proceed in his own interest, or if he recognizes that he is not so endowed intellectually that he could expect to survive creditably in the severe class-room and laboratory training that university-chemistry infers, then by all means let him enter a trade-school. He could not do better, in fact, than to enter for a training the scope and character of which is presented in this number by Prof. Allen Rogers, of Pratt Institute. Nor would he by so doing cut himself off from a genuine success. The industries are in point of fact desperately in need of scientific foremen; i. e., of men educated in chemistry and mechanics to an extent that enables them to co-operate sympathetically and practically with the officials of the company for the elimination of waste and for progressive factory practice; in addition, educated foremen may become superintendents, and superintendents managers, and managers presidents.

But if, on the contrary, the man concerned is interested in chemistry for its own sake, if he eagerly desires to become, genuinely, a scholar in chemistry fully equipped to add to the world's sum of knowledge both pure and applied, and if he has none of the hamperments stated above, then his course may be as follows:

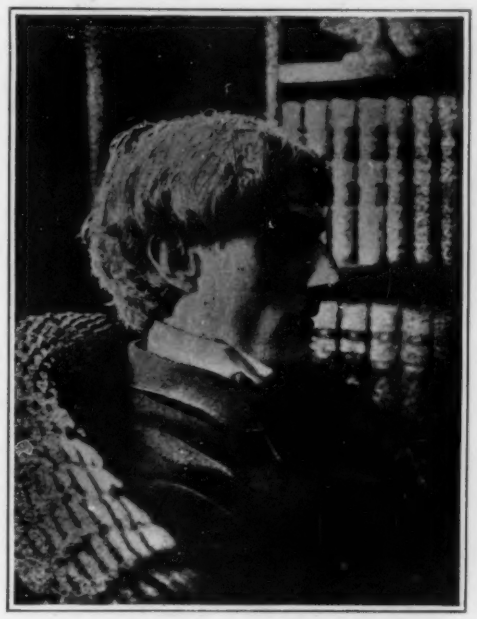
Before stating this, however, there ought to be said that any man proposing to become an industrial chemist should satisfy himself that when he is ready for work he will be able to qualify under the following demands:

(1) Training (scholarship).
(2) Creative power.
(3) Personal integrity.
(4) Physical health.
(5) Practicality; i. e., creative power under the control of common sense.
(6) The ability to govern workmen and to manage foremen.
(7) Personal qualities that would commend him to the officials of the company.

From this list it may easily be imagined that industrial chemistry is no game for old ladies or for little children.

Granted, however, that the man feels that he can fulfill these requisites, he has alternative courses.

He may enter the course in industrial chemistry in any one of the great universities or institutes of technology. In such a course, he will receive, together with a general theoretical and practical survey of the different fields of industrial chemistry, a considerable amount of pure chemistry, some engineering, shop practice, factory law, etc. Such a course in industrial chemistry, admirable in its scope and purpose, is offered by Prof. Whitaker, of Columbia University. The result of such a training is likely to be a man well trained up to his limits, hard-headed, practical and of great ultimate use to the factory which he enters in installing or managing the chemical end of an industrial plant—decidedly, in fact, a man that knows



Robert Kennedy Duncan

what he knows. The danger is that having been trained in *multa*, not *multum*, he may have a wrong conception as to his immediate use in such a factory; and since it is impossible under such conditions to give a comprehensive chemical training in a course of four years, he is likely always to be limited in his power to apply contemporary discovery to practical ends. Still, the industries need, and, indeed, must have men of this very type, and there is now and in the future there will be for them a continuous acceleration of demand. If the man concerned, through his natural qualities, desires to do this kind of thing, this is the kind of thing he desires to do—and there is as much opportunity for him as he could well desire.

The alternative course advises the man to enter the university carefully prepared to forget that he is purposing to become an industrial chemist, but instead of that, in a comprehensive way, a *chemist*. His course is to take all the chemistry that the curriculum prescribes or permits, and with it what other cognate or cultural study his time affords.

His course will require some four years of undergraduate study followed by two or three years of graduate study. At the end of this time, if he is the young man I take him to be, as a young doctor of philosophy indorsed by his university, he is prepared to take and can obtain an industrial position. He may enter this position without any pretense of knowledge as to the processes involved, but he may take the writer's word for it that, other things being equal, he will speedily surpass competitors who have experienced the other forms of training; he will, in fact, have nothing to limit him in becoming a supreme authority in his chosen field. It may be suggested, that seven years of university training is a long and costly course. As for time, it is worth it; as for cost, in the case of a man for whom alone industrial chemistry would be worth while, it certainly does not require a rich father. The ideal condition for the right kind of a man to enter the university assumes that his monetary resources do not exceed five cents; in other words, the price of a car-fare to get there. In the University of Kansas, thirty per cent of the students make their way, in whole, through the university, and sixty per cent in part. There is no man to-day worth his salt who cannot, depending solely upon himself, make his way through the university to the appointed end.

After passing through whatever training the man's circumstances or inclinations dictate, he may enter various types of industrial work, in which his training equally with his other qualities will determine whether or not he will stick or advance.

(1) Routine Analysis.—Such positions are filled for the most part by young men with but a modicum of chemical training or by chemists who have a particular liking for that type of work. Salaries for men doing routine testing work vary from sixty to one hundred dollars a month, but may yield as high as two hundred and fifty dollars a month. Advancement depends mainly upon qualities that serve to qualify men for executive work. A large number of such positions are open to-day in all parts of the country—in general commercial laboratories; in manufacturing laboratories, pharmaceutical, metallurgical, beet-sugar laboratories, etc., sanitary laboratories, and in various other fields of effort. Such routine positions are particularly valuable for chemists in training, in providing temporary positions by which a supporting income may be obtained for collegiate expenses together with valuable experience.

(2) Government Positions.—The Bureau of Chemistry, of Soils, and of Standards, of Mines, the Geological Survey, and various other branches of government constantly employ and are continually looking for skilled young chemists regularly graduated from the universities. While the salary stipends are not as great as the holders of these positions could for the most part obtain in industrial or even in instructional work, the positions themselves are exceedingly advantageous in confirming the training of the universities and in throwing the man into positions in field-work where initiative, self-reliance, fortitude and other manly qualities are developed. The danger related to such positions is that too long continuance in such work is likely to develop the chemist into a bureaucrat, sometimes of rather an offensive type. Chemical positions under government are good stepping-stones to desirable industrial positions. As is the case generally, the demand for good men in such positions far exceeds the supply. Apart from federal positions, all the States require and use many chemists in food, water, fuel, mining, criminal and other work.

(3) Works Chemists and Chemical Engineers.—These positions are rapidly on the way to become some of the most attractive in the whole field of industrial chemistry. As a member of the Committee on Employment of the Chemists' Club of New York, it is interesting to watch the character of the applications that continually arise from the various industrial companies seeking chemists. For example, the following positions are open:

Chemist versed in the manufacture of vinegar.

High grade industrial chemist or research engineer; work upon copper, lead and tin alloys, explosives, etc.

Man needed to do work in connection with toilet articles.

Chemist for drug company.

Assistant chemist to manufacture complete line of tablets and pills.

An A No. 1 laboratory man for wholesale drug laboratory.

Man thoroughly trained in laboratory work; a good manufacturer of pharmaceutical products.

Man with practical experience in the U. S. Patent Office work.

Chemist to conduct investigations on the distillation of wood for turpentine.

Two men who have had experience in work on soils, feed and agricultural products.

Chemist and superintendent for sulphuric acid and alum plant.

Assistant chemist for pharmaceutical work.

Man needed experienced in varnishes, japans, and paints. Work of experimental character.

Analytical chemist for powder company.

Assistant organic research chemist, of congenial personality; must be thoroughly trained in organic chemistry.

Instructor of junior and senior students practically entirely in chemical technology; engineering training required.

Chemist needed for the manufacture of ordinary pharmaceutical preparations.

Chemist for analytical work of a pharmaceutical laboratory, including drug assaying.

For zinc and chemical company, man experienced in the manufacturing of sulphuric acid by the chamber process.

Chemist in oil laboratory.

Assistant chemist, fats, oils, analytical work.

(Continued on page 262.)

Psychology and Advertising

The Scientific Appeal to Human Nature

By Edward L. Thorndike, Professor of Educational Psychology, Teachers College, Columbia University

PSYCHOLOGY is the science of human nature. Commercial advertising is the art of influencing human nature to buy certain wares. Advertisers are discovering that they need to know the facts which psychology can give about what attracts attention, what sticks in memory, what gives a pleasant impression, what persuades and what leads to a given act, here the act of purchase. Psychologists are learning that the responses of men and women to the illustrations and "copy" of "ads" are material for the scientific student's pure curiosity about the workings of the mind as well as for the economist or expert in business. So a new specialization of applied psychology is fairly started, its birthday being perhaps that of the publication of Prof. Scott's "Psychology of Advertising" in 1902.

No matter which of the many problems that confront advertising practice you choose, you are soon led straight into psychology—often psychology of a very technical sort—if you try to think the problem through to the end. To make known a breakfast food or soap, to connect its name or appearance or both with the fact that it *is* a breakfast food or soap may seem an easy problem for common sense. Rufton's Soap in big enough type, on enough pages, fences, and cards—the method of our childhood—is indeed straightforward and easily done. But common sense does not inform one whether so emblazoning *Rufton's Soap* on an eighth of a page eight times or on a whole page once, on a page alone or on a page with a picture, more surely captures attention and holds memory prisoner. It does not even distinguish between getting the human mind to think of "soap" when it happens to think of "Rufton's" and to think of "Rufton's" when it happens to think of "soap." Yet this difference may mean thousands of dollars.

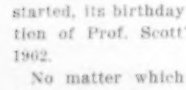


Fig. 1.—A strong claim on attention at small cost.

Putting Facts Before the Mind.

Common sense has indeed often made great blunders, neglecting clearness, pleasurableness and habit as causes of attention and over-emphasizing size and repetition, the costliest ways of catching the eye and mind. Even to-day the elementary laws of attention taught to beginners in psychology are not always followed. For example, no psychologist among my readers will doubt that Fig. 1 burns in its message, the name of an automobile, better than Fig. 2, and in a fraction of the space.

Fig. 2.—A weak appeal. Too elaborate, vague, and confused.

But the problem of putting a fact, or, more commonly, two facts in connection, into a mind, leads soon to far more subtle and technical matters. I choose only one for illustration—the laws of the action of the eye, which is the first enemy for an advertisement to win over. The eye, in getting its impression of a page, a wall, or a billboard, acts roughly as would a small camera, in getting a series of pictures which, pasted together, would make a picture of the total page, wall or billboard. That is, the eye does not see clearly much at one time, nor move in a continuous

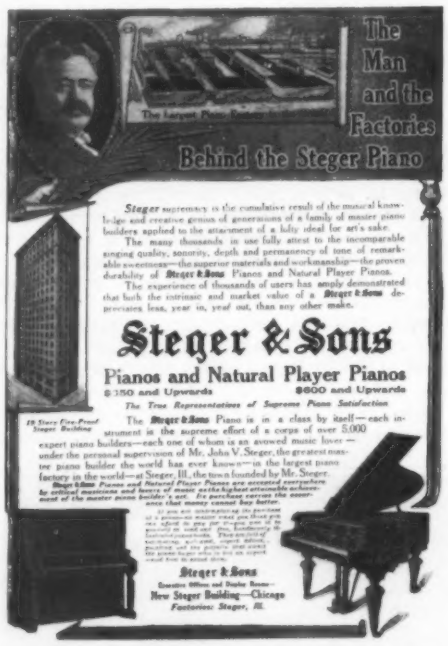
Fig. 3.—Too big type is a common error. An unnecessarily hard task for the eye.

The Man and the Factories Behind the Steger Piano
Steger & Sons
Pianos and Natural Player Pianos
$350 and Upwards
$800 and Upwards
The True Representatives of Supreme Piano Satisfaction
Steger & Sons
New Steger Building—Chicago
Factories: Steger, Ill.

Fig. 4.—A misapprehension of what the possible buyer of a piano wants. No connection forming here.

sweep to cover the object. It turns, stops for one to three tenths of a second, takes in an "eyeful," turns ahead or back, stops as before, takes in another "eyeful," and so on.

Getting an Eyeful of Advertising.

Means have been found to photograph the movements of the eyes in reading a page, examining a picture and the like, and measurements have been made of just how much the eye and understanding do take in during one stop—one exposure of the camera. The reader who is conscious only of looking at an advertising page in a magazine for two seconds and getting a view of it as a whole, really takes a dozen or so different "looks." The eye itself can not see the whole page at all clearly in one look or fixation. The eye sends up a piece-meal report which has to be *put* together. The task of the eye in glancing over a page is a complex task which may be done well or ill, easily or with a feeling of strain.

The advertiser should, of course, other things being equal, (1) make the labor of the eye as slight as possible, (2) furnish any material that the eye is to take in at one glance or fixation in the shape of a convenient "eyeful," and (3) arrange the "eyefuls" that are to catch the eye in its series of exposures in such a way that the piecemeal report they give will be most sure to be put together into the impression he desires to leave.

To meet these requirements even the expert advertiser needs special knowledge of the psychology of visual perception. Common errors are to make type *too large*, as in Fig. 3, so that a single fixation fails to give any whole phrase or word, or to so crowd and muddle printed matter that the eye moves about the page at random. Less commonly the eye is actually tempted *away* from the essential facts in the display.

To get attention to an advertisement is only a first step in a long pursuit of the mind, which must be at last forced by the laws of its own nature to write for and read a catalogue, to examine an article, or, most commonly of all, to buy it.

Intuitive Knowledge Supplemented by Psychology.

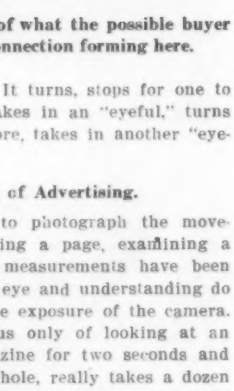
Experienced advertisers who have studied the results of many advertising campaigns get an intuitive appreciation of how men and women will be influenced by this, that and the other quality in an advertisement. Can such intuitions be usefully supplemented by the psychologist's knowledge of the laws of attention, perception, memory, suggestion, habit, inference and the like?

Let us ask, as a sample case, whether advertisers have anything to learn from one of the simplest of all psychological laws, a law of habit or connection formation, which states that a human being will, other things being equal, make to any situation that response which has gone with that situation most frequently, and with the most resulting satisfaction. Man thinks or feels or does what he has thought or felt or acted in like case with success. Will it profit an advertiser to think of the possible buyer as a mechanism that, whatever else it does, tends unreasoningly to keep together ideas that have come together?

This law leads to five obvious principles for controlling a person's mental connections.

1. Know what his situation is.
2. Know what response you wish to get from him.
3. Know what satisfies or annoys him.
4. *Make* the connection; do not expect the response to come as a miracle.
5. Other things being equal, make no connections which you will later have to unmake.

That these principles, which should be the A, B, C of any art of influencing human nature, are not thoroughly known to advertisers, is clear from the following facts: Advertisements almost exclusively to arrest the attention of a casual observer (e. g., advertisements consisting of an interesting but largely irrelevant picture with a mere note of the article and firm name) are used for articles like seeds, doorknobs, nursery stock, or coffins. This is wasteful since possible buyers of such wares would in a great majority of cases make a deliberate examination of advertisements of them, the situation including much interest on their part and a definite intention of comparing merits. Advertisers who use expensive attention-arresting display for such articles *do not consider what the possible buyer's situation is.* Looking cas-



Copyright 1910 by Ed V. Price & Co.

Fig. 5A.

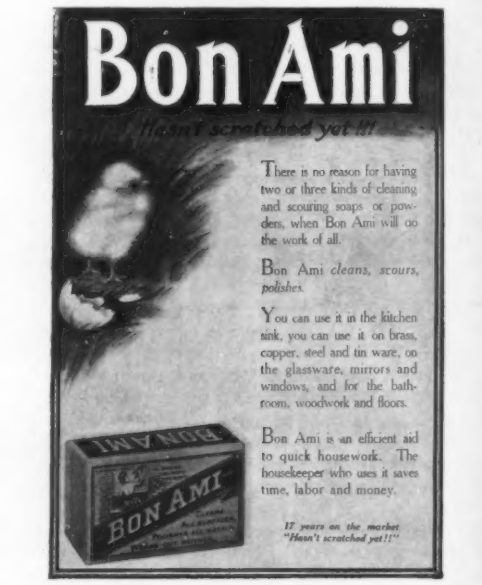


Fig. 5B.

The psychologist expects Fig. 5B to outlive Fig. 5A.

Bon Ami
Hasn't scratched yet !!!
There is no reason for having two or three kinds of cleaning and scouring soaps or powders, when Bon Ami will do the work of all.
Bon Ami cleans, scours, polishes.
You can use it in the kitchen sink, you can use it on brass, copper, steel and tin ware, on the glassware, mirrors and windows, and for the bathroom, woodwork and floors.
Bon Ami is an efficient aid to quick housework. The housekeeper who uses it saves time, labor and money.
17 years on the market "Hasn't scratched yet!!"
BON AMI

Fig. 6.—Perhaps the chicken may some day weary the public.

ually over a magazine, looking to find out where to buy a given article, and looking to find out which is the best article, are three radically different situations that obviously demand different treatment.

Getting the Right Kind of a Response.

Some advertisements are fitted to produce the response "readiness or desire to buy *a* motorboat, *a* piano, *a* greenhouse" as much as or more than the response "readiness or desire to buy *the Jones* motorboat, *the Smith* piano or *the Brown* greenhouse." The

The Easy-Made Dessert.

From the homely materials pictured here are produced desserts so beautiful and delicious that they appear to be the work of the fairies.

All that is required to make a Jell-O dessert in a package of

JELL-O

and a pint of boiling water. Dissolve the contents of the package in the boiling water. As soon as it is cold your dessert is made.

Just now, when the supply of canned fruit has given out, and it is too early for fresh fruit, the delicious fruit flavors of Jell-O fill their places and afford desserts that are especially seasonable and delightful.

The flavors are: Strawberry, Raspberry, Lemon, Orange, Cherry, Peach, Chocolate.

At all grocers', 10 cents a package.

The Jell-O price never goes up.

Beautiful Recipe Book, "DESSERTS OF THE WORLD." Free.

THE GENESEE PURE FOOD CO.,
Le Roy, N. Y., and Bridgeburg, Can.

The Birthday Party.

Nan is six years old. Mamma and Bobbie are giving her a party. And what a dinner Mamma has prepared! Just now she is serving a Jell-O course, and there is no mistaking the children's approval. They all like

JELL-O

because it is delicious and beautiful. It is so pure, wholesome and nutritious that it is better for them than any other kind of dessert.

A Jell-O dessert can be made in a minute. Simply add boiling water and let cool.

Seven delicious flavors: Strawberry, Lemon, Orange, Raspberry, Peach, Cherry and Chocolate.

All grocers sell Jell-O, 10 cents a package.

The beautiful new Jell-O Recipe Book, "DESSERTS OF THE WORLD," illustrated in ten colors and gold, will be sent free to all who ask for it.

THE GENESEE PURE FOOD CO.,
Le Roy, N. Y., and Bridgeburg, Can.

Fig. 7. Samples from a series of advertisements that are in the main in accordance with psychological principles.

response which any competitor equally desires is confused with the response which the advertiser himself should seek. Certain features of many advertisements of automobiles, Portland cement, bathroom fittings and office furniture make this error. In some such cases a real profit-sharing of supposed competitors may be the reason, but even in such a case it is wasteful to encourage a response as beneficial to future competitors in the same trade as to the advertiser.

Neglect of the third rule, "Know what satisfies or annoys the prospective buyer in the case in question," is very common. Does not Fig. 4, for example, show a misapprehension of what the possible buyer of a piano wants? The pictures of the factories and office building seem psychologically fitted to appeal to a man to place a mortgage or perhaps invest in the company's stock, but not to appeal to the desires and aversions of a music-lover in respect to a piano. Are the pictures of the man and the hall-mat borders likely to connect the idea of a pure, rich tone and of beautiful music with that particular piano? Would not the general make-up—the arrangement of cuts and type—positively irritate anyone of an artistic temperament?

The fourth rule—to make connections, not expect them to come of themselves—seems at first thought childish. But did the "Sunny Jim" "ads" connect a given breakfast food inevitably with ideas of delectability, health and vigor, suffuse the very name of that food with a charm for appetite, and bind to the sight of its package a strong impulsion toward purchase?

On the contrary, I venture to predict that many of my readers who remember Sunny Jim do not even remember what breakfast food was supposed to have made him sunny; and that many others have, as a result of the "ads," the hardly more valuable connection of thinking of the food in question as the subject of a vigorous advertising campaign in connection with pictures and jingles about a rather ridiculous looking little old gentleman.

Making the Connection.

As a matter of fact, the greatest amount of psychological ingenuity is demanded to "make the connection," simple though it sounds. To connect the article and the name, to connect each desirable quality with the name, to connect that name with the ideas of purchase and possession—each may be a most intricate task, involving, like a problem in chess, the interrelations of dozens of factors. Disturb one adjective, leave one preparatory advertisement ineffective, overdo one element in the picture and the whole attack may fail.

I have willfully chosen samples of inadequacy from the best modern advertising practice, in order to make the point that violation of the psychological laws of closeness, relevance and concreteness are perilous to even the most expert writer of advertisements. For perfectly clear cases one may take those given by Prof. Scott of the picture of a breakfast food carton with vermin crawling over it, and of the underwear company which received many orders as a result of a second company's advertisement, the second company's "copy" having been so placed as to connect more readily with the first company's name and address than with its own!

The last warning, against making connections only to have to break them later, should protect any advertiser from many risks. For example, the emblem, slogan or means of attracting attention to the "copy" should not risk boring or disgusting readers in the long run for the sake of an exciting appeal for the time being. A history of advertising would, I am sure, prove that the grotesque, the merely strange, and the fantastic have been thus dangerous.

A psychologist would prefer not to risk his fortunes on the habits formed by repeated impressions of

Come Packt furniture,
U-All-No after-dinner mint,
Slide Well collars,
Breathe-rite braces,
Corn Dodger shoes,
Holeproof hosiery,
Pre-Shrunk garments.

Yet these are all modern devices used to gain the trade of critical people.

The psychologist expects Fig. 5B to outlive Fig. 5A as a catch-sign, and predicts that even the charming chicken of Fig. 6, that "hasn't scratched yet," may in the long run bore the public and have to give up his place to the safer picture of the soap itself.

I have so far illustrated the value of knowledge of one sample law of human nature—a law of habit—by showing the bad effects of its neglect. On the positive side, I should claim that many of the excellencies of Fig. 7 could have been planned and can be accounted for by the psychological principles of association or connection-forming.

Finally, I have chosen two "ads," Fig. 8A and 8B, which superficially seem much alike, but one of which I regard as very good and the other as very bad on purely psychological grounds. Let the reader decide which is which, and why!

Yeast as a Food

THE breweries of Germany produce annually over 70,000 tons of yeast, which is for the most part wasted. For several months there have been going on systematic experiments under the direction of Prof. Delbrück, of the Berlin Institute for Fermentation Industries, for the purpose of finding some practical means for utilizing this product. Special attention has been directed to the problem of its possible availability as human food.

There are a number of commercial preparations on the market which consist essentially of dried yeast; these combine the qualities necessary to adapt them to use as food, having an agreeable taste and odor and a chemical composition comparing favorably with other high-protein foods. When properly prepared, dry yeast keeps indefinitely without danger of deterioration; and its high protein content would make it one of the cheapest foods. The slightly bitter taste characteristic of fresh yeast can be readily removed by treatment in the cold, before drying, with a solution of sodium carbonate.

Messrs. Voetz and Baudrexel, of the Institute, have determined its adaptability to the nutrition of man and other animals. The chemical composition of the dried yeast, as compared with average samples of beef, is given in the following table:

	Dry Yeast.	Beef.
Water	6.9%	72.5%
Protein	53.4%	21.0%
Calories per lb. (approximate)	2,000	607

From the above it is seen that the protein value of the yeast is about two and a half times that of meat; and that the fuel value of the former is over three times that of meat.

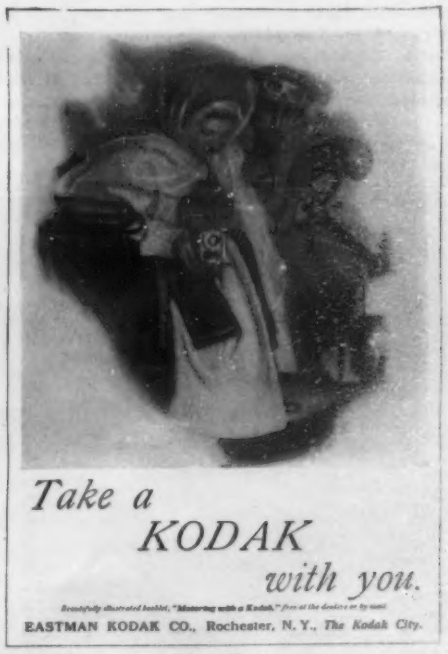
Experiments made in feeding dogs showed that 87.2 per cent of the nitrogen in the yeast is assimilated. Large quantities of this material were used on the dogs without producing any symptoms of inconvenience or disorder. Among the animals were some females suckling their young; these seemed to thrive very well under the conditions of the experiment.

A number of the employees of the Institute replaced a portion of the meat in their diets with dry yeast powder using 2/3 ounce with each breakfast for several weeks. No unfavorable results were produced.

The New Salesman Rebuked.

"Excuse him, Madam. He has not yet learned that our best class of customers all mean **PETER'S** when they ask for Eating Chocolates. They know from long experience that it deserves its great reputation for Purity, Wholesomeness, and Digestibility."

Fig. 8A.



Take a
KODAK
with you.

Beautifully illustrated booklet, "Mastering with a Kodak," free at the dealers or by mail.

EASTMAN KODAK CO., Rochester, N. Y., *The Kodak City.*

Fig. 8B.

A psychological analysis shows that Fig. 8A and Fig. 8B, though superficially alike, are almost complete opposites. One is good and the other not. Which is which?

How Electricity Is Aiding the Chemist

(*Continued from page 243.*)

methods for less than one dollar per pound. In 1889 Mr. C. M. Hall discovered and perfected his electrolytic method by means of which aluminium can now be sold at less than twenty-five cents per pound. The oxide of aluminium, a cheap raw material, though insoluble in most solvents and infusible at ordinary temperatures, dissolves in molten alkaline fluorides like sugar dissolves in water. From this molten solution the metal is separated by the passage of an electric current, and appears at one electrode while the oxygen is set free at the other. The use of aluminium where lightness and strength are desired as in automobile and airship construction is well appreciated, and to its cheap production much of the success in these industries depends.

Heat From Electricity.—Although heat derived from electricity is very many times more expensive than heat obtained by the burning of ordinary fuels, there are two conditions which make electrically generated heat of great service to industrial chemistry. These are:

1. Heat generated within the zone of chemical reaction.

2. Heat generated at a temperature higher than that attainable by burning fuel.

1.—In the great majority of chemical reactions, owing to the necessity of carrying away the waste gases produced by combustion, the heat thus generated must be conducted through a containing wall to the material undergoing chemical action. Not only is this in itself wasteful of fuel, but frequently the high temperature necessary on the outside of the container is so destructive of the containing vessel as to render the cost of operation prohibitive. Since when an electric current passes through a conducter of high resistance great heat is generated in the conducter it is only necessary to place this conducter within the container in order to generate the heat at the point where it is needed. The walls of the container can thus be maintained at a much lower temperature than would otherwise be the case, which greatly prolongs their life.

An example of the use of electric heat generated within the reacting vessel is in the manufacture of phosphorus. Although it was known for many years that a mixture of sand, coke and bone-ash when highly heated would produce phosphorus, the reacting mass so soon destroyed the containing vessel as to render the process a failure. By passing a current between carbon electrodes in a firebrick furnace, and feeding the mixture in such a way that the walls of the furnace are constantly protected by some of the unacted upon charge, the process is made continuous and the cost of the material greatly reduced. All of the phosphorus of the great match companies is now made in this way.

Another example of the use of internal electric heating is in the manufacture of carbon-disulphide, a liquid used in large quantities in protecting wheat and other grain from the weevil. This chemical was formerly made by passing sulphur vapor over hot carbon in an iron retort. These retorts lasted so short a time, that the price of carbon-disulphide was never less than twenty-five cents per pound. By heating the carbon to incandescence by an electric current the retort may be replaced by a firebrick furnace of large size and the material made so cheaply that it is now sold for less than four cents per pound.

But by far the most important application of internal electric heating is in the manufacturing of steel. The older methods of making steel by the Bessemer and open hearth processes while capable of turning out an immense tonnage are both limited in the extent to which a steel free from dissolved gases, oxides and other undesirable constituents can be produced. The gases of combustion are always present to contaminate the product. When made by the so-called crucible method, in which an amount not over 100 pounds is melted in a graphite crucible, a high grade product is obtained, but the cost is necessarily high. By the application of the electric furnace to steel making a gap which has long existed will be filled and a steel better than the open hearth but cheaper than crucible

Courtesy *Metallurgical and Chemical Engineering.*

Tapping a silicon furnace.

steel will be offered the consumer. There are a number of types of furnaces in operation in both America and Europe, some having a capacity of fifteen tons. Doubtless the most important field for the electric furnace in the steel industry is as a finishing furnace for the Bessemer converter. This method is already in use in the United States and is apparently giving very promising results, combining, as it does, the very cheap preliminary refining in the Bessemer process with the perfect finishing condition of the electric furnace. The great usefulness of the electric furnace in the preparation of a high grade steel at moderate cost is only beginning to be realized.

II.—The temperature attainable by the combustion of fuel is naturally limited to the dissociation temperature of the product of combustion; in other words, to the temperature where the carbon and hydrogen of the fuel will no longer combine with the oxygen of the air to generate more heat. This is approximately 2,000 deg. C. In the electric furnace the heat generated by the passage of the electric current is limited only by the amount of electric energy available, and the volatilization point of the material forming the conductor. Carbon does not break up until a temperature of about 3,700 deg. C. is reached, and hence a temperature of this hitherto unthinkable intensity may be realized.

With such an enormous temperature, or even much below this upper limit, many reactions are possible which do not take place at the maximum temperature attainable with fuel, and the working horizon of the chemist is thus greatly widened.

Calcium Carbide.—The great chemist Wöhler some fifty years ago made calcium carbide by uniting metallic calcium and carbon, and generated from it the wonderfully brilliant illuminator, acetylene gas. But it was not until the advent of the electric furnace that calcium could be obtained direct from its ore, and lime and calcium carbide produced in large quantities. It is made very simply by heating to a very high temperature a mixture of lime and coke, or other form of carbon. The product is tapped in the molten condition from the furnace much as is the case with cast iron. The magic of the electric furnace has transformed the dull and slow burning coke into a compound which with water yields a gas brim full of energy and capable of giving a light of the greatest brilliancy. A new use is developing for calcium carbide in the fixation of atmospheric nitrogen. The plant world might paraphrase the lament of the shipwrecked mariner and say "Millions of tons of nitrogen and not one pound to use." Although the air is 80 per cent nitrogen, it is not in a form available for plant growth. It has been found that when this nitrogen gas is passed over moderately heated calcium carbide, a union takes place, and a compound of calcium carbon and nitrogen called calcium cyanamide is formed. Under certain conditions this compound is a nitrogenous fertilizer and can be used instead of other forms of fixed nitrogen as a food for growing crops. A large plant for the manufacture of cyanamide has lately been finished at Niagara Falls, Canada.

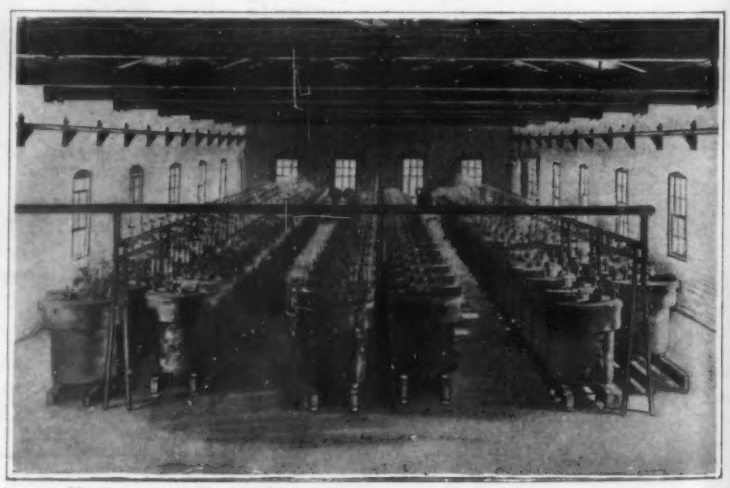
Carborundum.—A second carbide, but one entirely different in its properties is known as carborundum. This is made by uniting silicon and carbon at a high temperature, and forms an exceedingly hard mass which is used as an abrasive, much as emery is used. A mixture of sand (oxide of silicon) and coke is placed around a resistor of carbon and highly heated. After the furnace has cooled a mass of beautiful crystals, brilliant in color and exceedingly hard, is found concentric with the carbon. This mass is pulverized and worked up into abrasive objects of all kinds and is known and used the world over. Again the magic of this intense heat has produced from common sand and coke, a mass of brilliantly beautiful crystals; a splendid butterfly from the common grub.

Graphite.—If in making carborundum the temperature is carried too high, instead of masses of the carbide of silicon there is found only the carbon constituent; but this is now in the form of graphite. This observation gave Mr. Acheson, the inventor of carborundum, a clue which when followed out produced what is universally known as Acheson graphite. Before this discovery we were dependent upon the graphite scales obtained from Ceylon and Siberia, which had to be laboriously worked up into the finished article. Now the article, whether it be a crucible, electrode or what not, is formed of coke and pitch, and when baked is intensely heated in an electric furnace when it is converted into the purest graphite. This method of forming graphite electrodes has been an inestimable boon to the entire electro-chemical profession and has been an important factor in the progress of the art.

Silicon.—Instead of reducing the silicon from sand (oxide of silicon) and then combining it with carbon to form carborundum, it has been found possible to so conduct the operation that the metal silicon is formed in large quantities. A few years ago the element was a curiosity, now it is made and marketed by the ton.

Space forbids extending the list of applications of electricity to chemical industry, but enough has been written to demonstrate the marvelous development which has taken place in the last fifteen or twenty years. What the future holds for the enterprising investigator, no one can foretell.

Carbon bisulphide plant of Edward R. Taylor in process of construction.



Courtesy *Metallurgical and Chemical Engineering.*

Manufacturing oxygen and hydrogen by electrolysis of water.

SOME EXAMPLES OF THE COMMERCIAL APPLICATION OF ELECTRICITY TO CHEMISTRY

The Technically Trained Foreman

Educating Men to Co-operate with Expert Chemists

By Allen Rogers, Ph.D., Pratt Institute

A CHEMIST for one of the large varnish factories near New York city had worked out a formula for what appeared to him to be a very high grade product. He turned the formula over to the varnish maker with the request that he make up a batch in a practicable way. The varnish was made, but when tested failed absolutely to give the anticipated results. On making an investigation it was found that rosin had been intentionally substituted for the fossil gum that was designated in the formula.

In a tannery where a pack of skins was being treated by a new process of bating, the foreman turned in steam so as to convert the stock into gelatine, and then claimed that the process had dissolved the skin.

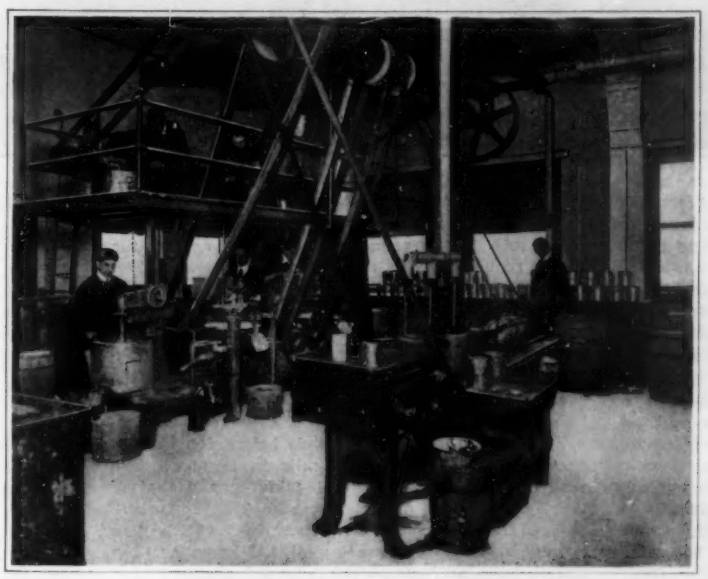
Many other instances of this sort could be cited, showing on the part of foremen a disposition to hamper the work of a chemist. It is safe to say that three out of five foremen to-day will do all in their power to make an experiment go wrong, while even men in higher positions will often disparage the chemist's efforts and take the advice of a so-called practical man. To be sure the chemist is often wrong, but usually for the reason that he has been given no opportunity to become familiar with the actual working conditions. The real reason for the lack of co-operation between chemists and foremen lies in the fact that the average foreman or superintendent, being very jealous of what he knows, is afraid that some one higher up will discredit his ability, while at the same time he may fear that the chemist will get his job. On the other hand, the chemist is often to blame as he approaches the man with an "I know everything" attitude, which from the start antagonizes the one with whom he should be on friendly terms.

It is the object of the present article to show what is being done to improve industrial conditions by giving the foreman a technical training. This has involved a radical departure from the usual method of chemical instruction. The writer humbly begs your indulgence for going into detail when referring to this work which is so close to his heart.

In September, 1905, the Pratt Institute inaugurated a new course, known as Applied Chemistry, at which time the writer was appointed to take charge of the Industrial Chemistry. He was directed to equip his laboratory and arrange his course so as to give the student a training along such lines as would have a practical bearing upon manufacturing operations, and would fit the students to become foremen, superintendents and heads of departments in our numerous chemical industries.

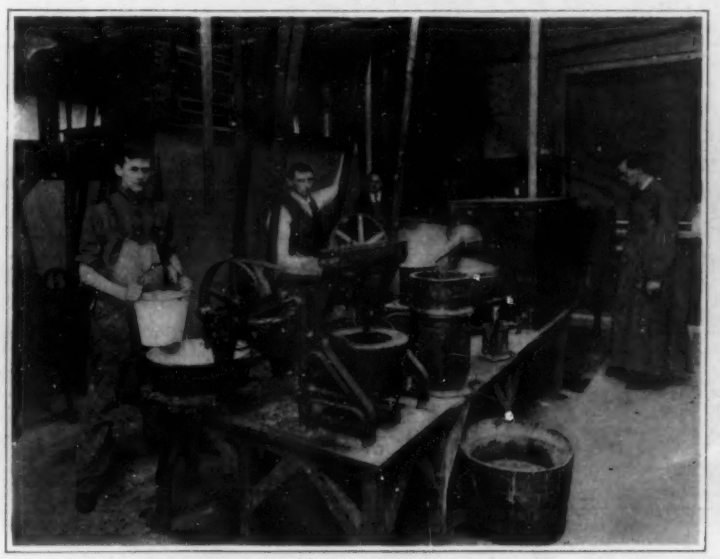
As no other schools were giving such a course it became a matter of originality, to work out the details of which was no small undertaking. To meet the demand of a large number of young men who could not afford the time or money for a four year course with college requirements, the course was made but two years in length, and only such subjects included as had a direct relation to manufacturing operations. To afford the necessary practical instruction, five miniature factories were installed, consisting of Chemical Works, Soap Works, Dye Works, Paint and Color Works, and a Tannery.

In opening the year's work one man is assigned foreman of the Chemical Plant and is given four of his class-mates as assistants. Here the preparation of chemicals is carried out on a fairly large scale and the students become familiar with the handling of steam jacketed kettles, vacuum pans, vacuum pump, vacuum filter, filter press, stills, centrifugal machine, and drying ovens. It is not only the idea of showing how certain chemicals are made, but the broader question of operating typical apparatus which is of the most importance. The foremanship system is of value as it gives the student experience in handling men and assuming responsibility. All orders also are given directly to the foreman who in turn must transmit them to his men, and must see that they carry out each operation with accuracy and dispatch. It is part of his duty, likewise, to see that his men are kept busy, that his factory is kept clean, that his machinery is in perfect condition and that all products manufactured should be made at a profit. The student assigned as oiler each week also reports to the foreman for instruction. As one group of men finishes the assignment in the chemical works another takes its place and so the work continues.



Where paints are mixed and tested.

A corner of the tannery.



A part of the chemical plant.

MINIATURE FACTORIES WHERE FOREMANSHIP IS TAUGHT

Those men of the class not employed in the industrial laboratory are engaged on analytical problems in the technical laboratory where they are required to make a complete analysis of such substances as water, gas, coal, cement, soap, oils, pigments, paints, tanning materials and other commercial products. It is the belief of the writer that the analysis of such materials not only familiarizes the student with common analytical problems, but at the same time gives him experience in quantitative separations which will apply to unknown substances more readily than if he had been given abstract analytical problems to solve; and further, as these are some of the common substances encountered in the works laboratory he is prepared from the start to undertake such analyses. It is not the object of this course, however, to turn out analytical chemists and this training simply supplements the more important industrial instruction.

When the first group of students has remained in the technical laboratory for two weeks it is assigned to the industrial laboratory again, but this time to the Soap Factory. In this factory not only are various kinds of soaps prepared, with the corresponding instructions regarding the value of the fats employed and the theory of saponification explained, but the student becomes familiar with the apparatus and machinery used in this industry. In this plant he is given more confidence in himself than in the chemical works; for the product which he makes must be of the highest quality to escape the criticism of his class-mates, and what is still more important, it must be good enough to sell. During the past year 4,000 pounds of toilet soap were made in this model soap factory, all of which found a ready market. The equipment of the soap factory consists of an eighty gallon lye tank, five hundred pound kettle, one hundred pound crutcher frames, slabber, cutting machine, chipper, stone mill, plodder and press.

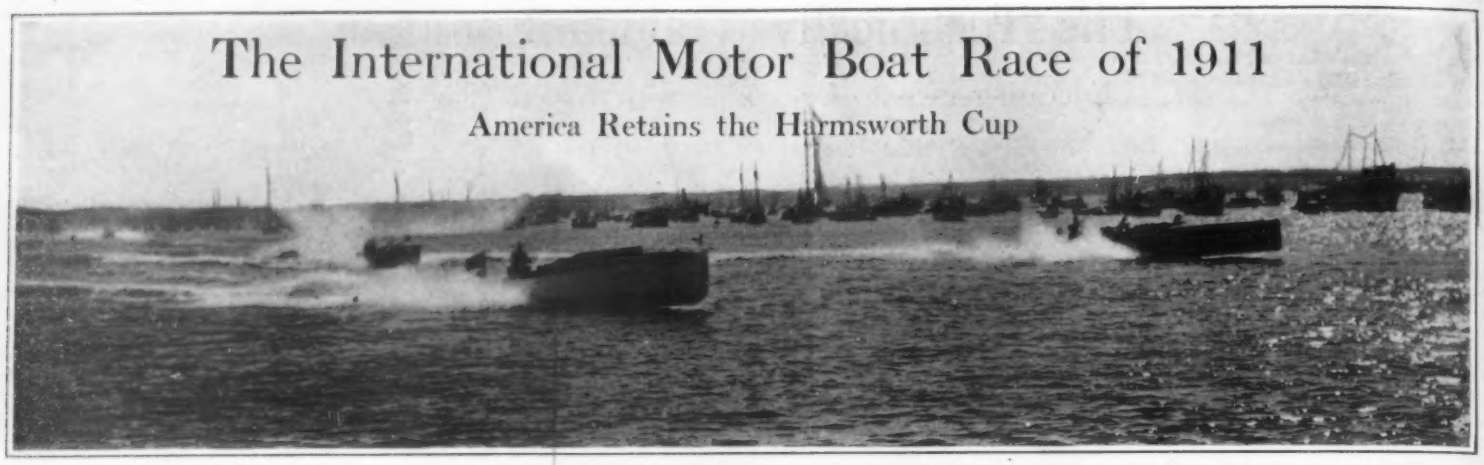
Next in order comes the Paint and Color Works, the equipment for which consists of color tanks, filter press, ball mill, kneading machine, change-can mixer, iron mill, two water-cooled 20-inch buhr stone mills and liquid mixer. During the past year over 400 gallons of ready mixed paints were made by the students at work in this factory all of which was sold and gave entire satisfaction. Besides the regular work a large number of white paints were made for the American Society for Testing Materials which will be tested out on fences erected in Washington for the purpose.

In the model Tannery the group is next assigned. Various processes of vegetable and mineral tannages are carried out together with all of the operation involved from the raw material to the finished product. The equipment for this factory consists of a leach house, soak pits, lime pits, suspender pits, layer pits, paddles, mills, fleshing machine, shaving machine, union splitter, setting out table,

(Continued on page 27...)

The International Motor Boat Race of 1911

America Retains the Harmsworth Cup



WHEN, last year, the fleet hydroplane "Pioneer" of the Duke of Westminster all but won the Harmsworth Cup, and showed a speed of forty miles an hour, American motor boat enthusiasts awakened to the development of the hydroplane. It was apparent that a displacement boat like the "Dixie III." would not stand a chance against a hydroplane, provided the latter had no mishap. As a consequence, a syndicate composed of H. H. Melville and Frederick K. Burnham, the Commodore and Vice-Commodore of the Motor Boat Club of America, and Mr. August Heckscher, a member, commissioned Clinton H. Crane to design a hydroplane capable of defending the cup. Mr. Crane, the designer of the other "Dixies," designed a single-step hydroplane, and equipped his craft with two 250 horse-power 8-cylinder V-type Crane motors driving twin screws. This new boat, the "Dixie IV.," is said to have made a speed of 45 knots for several miles. Our photograph shows her at her highest possible speed during a private trial before the race.

In order to win the trophy this year, it was decided that the vanquishing boat must lead in two out of three races. The first of these races was run on Labor Day, September 4th, under perfect weather conditions. The British team consisted of the "Maple-Leaf III.," a speedy English hydroplane fitted with two 12-cylinder motors of 375 horse-power each, which is claimed to have made 49½ knots over a mile course on the Solent; the "Pioneer," another hydroplane designed by an American, Mr. Wm. H. Fauber, and fitted with a 12-cylinder Wolseley-Siddeley engine of 380 horse-power; and the "Tyreless III.," a displacement boat fitted with two Brooke engines of 120-horse-power each set in tandem.

The American team, headed by the "Dixie IV.," also contained the "Disturber II." and the "Viva," both of which were chosen at the eleventh hour. The latter is a displacement boat fitted with four 6-cylinder 100-horse-power Emerson two-cycle motors arranged in pairs in tandem, while the "Disturber II." is a Fauber hydroplane, owned by James E. Pugh, of the Chicago Yacht Club. She is 31 feet 10 inches in length, and is equipped with two 8-cylinder Stirling motors of 130 horse-power each.

As usual, the 1911 race was held in Huntington Bay over a triangular course of 7½ nautical miles. Four rounds of this course were required, making a total of 30 nautical miles. The start of the race is shown in the photograph which heads this article. The "Dixie IV." led from the start, but was closely pursued by the "Pioneer." The powerful "Maple-Leaf III." broke her steering gear near the end of the second round, and was towed to her anchorage. The "Tyreless III." also gave out after covering 18 nautical miles, and she, too, was towed in. As neither of these boats was disabled so that they could not proceed under their own power, they were both disqualified, and in the second race the "Dixie" had only the "Pioneer" to vanquish. Throughout the first race on Labor Day, the "Dixie" maintained her lead, and finally crossed the line 59 seconds before the English boat, and more than half a mile in advance. The time of the "Dixie" was 51¼ minutes, and that of the "Pioneer" 52 minutes 14 seconds. The "Disturber" finished in 52:42, and the "Viva" in 1:04:12. The average speed of the winner was 35.12 knots, or 40.38 statute miles an hour. The "Pioneer" averaged 34.42 knots, or 39.62 miles an hour. As the "Dixie IV." made 39.86 knots, or 45.83 miles an hour, in the elimination race five days previous, it is apparent that she is much the faster boat. It was not found necessary to let her out in the first race, and even less so in the second. The "Disturber II." averaged 32.31 knots and the "Viva" 27.97.

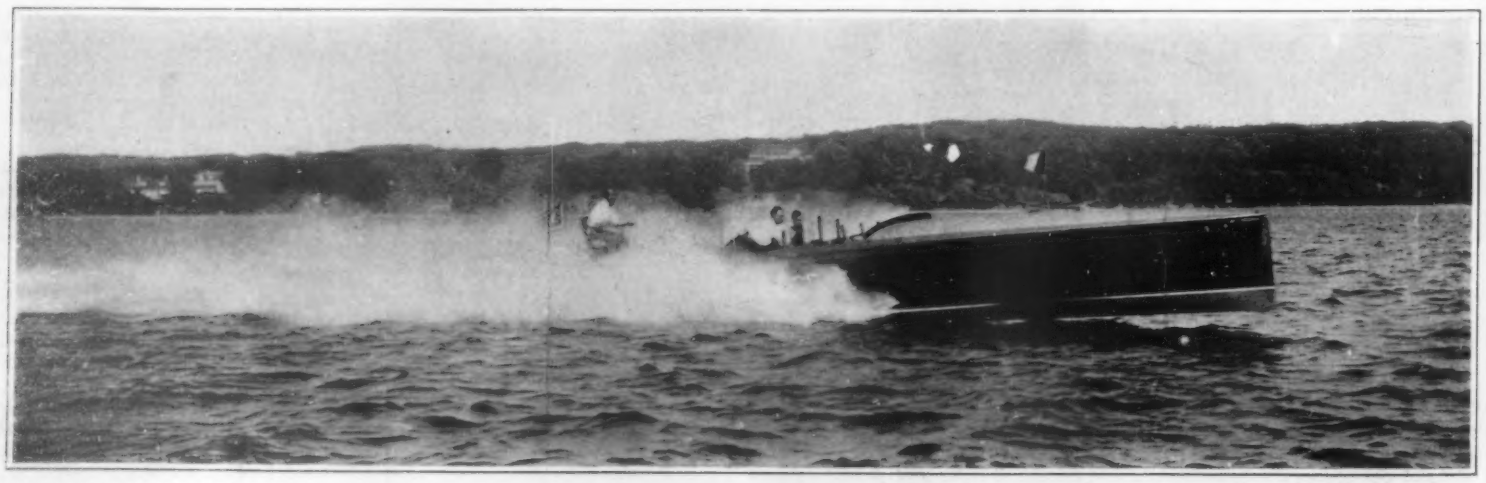
In the second race on September 5th, the "Pioneer" was slightly ahead of the "Dixie" at the start, but the latter overhauled and passed her on the second leg of the course, and at the end of the first round was four seconds in the lead. A heavy wooden packing box in the wake of the "Pioneer" was hit by the "Disturber II." damaging her severely. Her owner beached her before she filled sufficiently to sink. Soon after the start of the second round the British boat was obliged to stop owing to engine trouble, and during the 19 minutes she was at rest the "Dixie" lapped her and continued steadily to the finish. The "Pioneer" got under way again and was apparently good for second place; but again the unexpected happened. Her propeller shaft broke while on the last leg of the final round, and within sight of the finish. Consequently the laurels went to the "Dixie," which was a minute and 32 seconds longer in covering the 30 nautical miles than on the previous day, averaging 33.43 knots; and to the "Viva," which averaged 23.06, or 27.5 statute miles an hour.

For the first time, in the race this year, America made an excellent showing both as to speed and reliability. All three of our boats finished the first race, and but one dropped out of the second, owing to an unfortunate accident and to no fault of the machinery or hull.

While the Duke of Westminster did not see fit to increase the power plant of the "Pioneer," and even was willing to wager $100,000 that she would win, the men who built the cup defender doubled her power plant and installed two 8-cylinder V-type four-cycle motors of 250 horse-power each. The motors have a bore and stroke of 7¼ inches, and make a maximum speed of 950 revolutions per minute, although, in the race, they ran at only about 800 revolutions per minute. The "Dixie IV." has twin screws, one propeller shaft being directly coupled to the forward motor, while the other is driven by spur gears from the rearmost motor. This was made necessary on account of the steep inclination of the boat and propeller shaft when under way. A novel feature of the "Dixie IV." is the attaching of a metal step beneath the hull directly under the forward engine. This arrangement makes it possible to build as staunch a hull as is obtained with any displacement boat, and the action of the single step is certainly very satisfactory. The "Pioneer," it will be remembered, has multiple steps according to the Fauber patent. In all there are five of these steps constructed in the bottom of her hull.

The fact that none of the American boats gave out on account of engine trouble speaks well for American motors, which have heretofore not shown up to good advantage in international or other races. The "Viva" was equipped with Emerson standard 6-cylinder, two-cycle motors, and she ran very regularly in both races. This is the first time that a two-cycle motor has been used in an international motor boat race. Despite the fact that the "Viva" is a hydroplane equipped with four 100 horse-power, extremely light weight, two-cycle motors, she did not at any time develop a speed of much more than 30 miles an hour, although her regularity was very good. The "Disturber II." was equipped with two standard four-cycle motors of the 8-cylinder V-type, and this boat also demonstrated the reliability of the engines besides showing fairly good speed. True to her name, she disturbed the water to a great extent, and made much more fuss than any of the other craft.

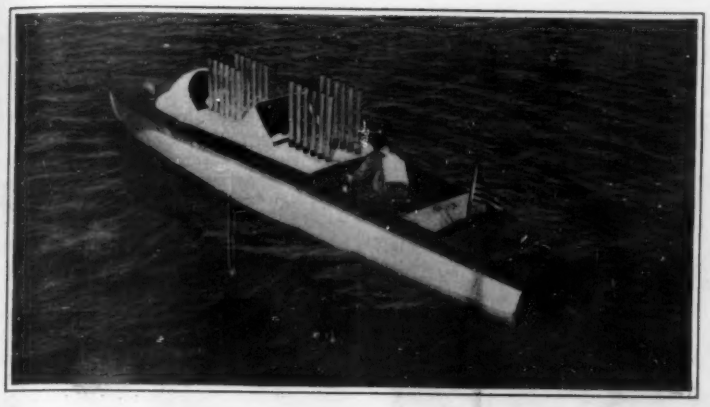
Now that America has won the Harmsworth trophy for the third time in succession, it is to be hoped that our motor boat enthusiasts will keep it here permanently by building other higher-powered and more advanced types of boats for the future annual races.



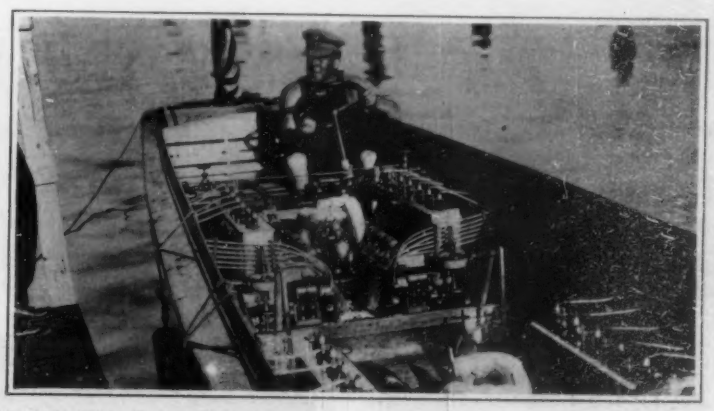
Copyright 1911 by Edwin Levick.

The "Dixie IV." making a tremendous burst of speed and skimming the surface at nearly fifty miles an hour.

THE WINNING BOATS AND ENGINES IN THE HARMSWORTH CUP RACE



The "Viva," a Fauber hydroplane equipped with four 100-horse-power motors.



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The four 6-cylinder Emerson 2-cycle motors installed in the "Viva."

Halos and Rainbows

THE correspondence columns of the scientific journals are overburdened with letters from persons who have witnessed one or another of the optical phenomena of the atmosphere, and who describe the same in such a way as to give the impression that they have never opened a book on optics. Strange to say these letters frequently come from men who are more or less prominent in the scientific world. One can hardly escape the conviction that a large number—perhaps the majority—of physicists, meteorolgists and astronomers have profited little by the researches of Monge, Biot, Bravais, Mascart, Pernter and other students of atmospheric optics.

There is, for example, a particularly beautiful form of halo—the "circumzenithal arc"—which is nearly always described by persons who thus report their experience as if the phenomenon in question was one of which they had never heard, and which they are consequently unable to call by its correct name or bring into relation with other luminous meteors. A description of this kind appeared in *Nature* for May 11th, 1911 (p. 349). The writer, who obviously had not the slightest acquaintance with the terminology of optics, referred to what he had seen as a "rainbow," Strange to say, the editor naively concurred in this ignorant diagnosis, and published the letter under the heading "A Zenith Rainbow;" notwithstanding the fact that, in a note appended to the letter by a well known meteorologist the correct name was applied to the phenomenon.

Several forms of halo are decidedly common, though they often escape the attention of the casual observer. At the Observatory of Montsouris, near Paris, where halos are systematically watched for, the circumzenithal arc was seen on 111 days in ten years; an average of one day in 33.

The Saharan traveler who has occasion to mention a camel does not call it "a large brown quadruped with a hump on its back." He saves times and obviates misunderstandings by saying "camel." On the other hand persons constantly report that they have seen in the sky a luminous appearance of such and such as size and shape along with other particulars that may or may not possess real scientific interest; the gist of which is merely that they have witnessed the tangent-arc of a halo, a sun-pillar, a lunar cross, a parhelion, or some other luminous meteor that ought to be, but is not, perfectly well known to the majority of educated people.

The SCIENTIFIC AMERICAN believes that its readers will welcome the appearance in its columns, in the near future, of a series of illustrated and plain'y-worded articles on the optical phenomena of the atmosphere.

The "Mouth-organ" Industry

TROSSINGEN, in the Black Forest of Germany, is the center of the foreign harmonica industry, where most of the world's "mouth-organs" of the cheaper grade are made. One factory alone is said to employ several thousand hands; and the number of harmonicas turned out by all the factories there is enormous, amounting to almost a million annually.

Although the United States imports a large number of the cheap German "mouth-organs," the finer grades are made in this country, and these are held to be equal in every way to the more expensive instruments made abroad. The Germans devote some attention to the manufacture of the more costly "mouth-organs," but their principal output is the cheaper grade.

Among the finer grades of harmonicas are the kind known as "concert," which come in sets of from four to a dozen and sell for several dollars apiece. These are tuned in various keys. In one form they show six harmonicas of different keys grouped about a central stem. Many of the elaborate and expensive harmonicas are handsomely decorated with designs of gold and silver upon mahogany. The wood used in the cheaper grades is pine.

Portable Swimming Tanks

A LARGE and permanent swimming tank is a costly affair, especially if it is located in the center of a large city, where ground is valuable. Many German cities are provided with such establishments, but many others have been deterred from following the example by the great cost involved, which may be estimated at about $100,000. The swimming bath in Munich cost more than twice this sum. Attempts to provide cheap substitutes for these expensive establishments have hitherto been fruitless. The first practical solution of the problem is exhibited at the International Hygiene Exposition in Dresden this summer and is described in *Hygieia*, the bulletin of the Exposition. This first portable swimming tank was designed by H. Recknagel, a well-known engineer of Berlin, and was opened on the 14th of May. The basin for an establishment of this kind can be constructed cheaply of concrete on any plot that is likely to remain vacant for a number of years in a central and accessible part of the city. The cost of a cheap basin of this kind will be covered by the revenues in a comparatively short time, and when the land is required for building, the basin can be rebuilt on another vacant plot. The water can be obtained from a river, lake or spring, or even from the city mains, as the quantity of water required will not be very great if the English filtration system is employed. By continuous purification of the water in this way, the number of bacteria per cubic centimeter in the bath can be reduced, according to the latest investigations, below the number found in the freshly entering water. A light shed with a canvas roof which will protect the bathers both from the heat of the sun and from cold winds can be cheaply erected over the basin. These movable swimming baths are equipped with locomobiles which will be found useful for various purposes, including the heating of the water and the air in cool weather, thus prolonging the bathing season, the operation of the pumps and filters, etc. The locomobile can also be employed for the production of waves by means of the simple Hoeglauer system, by which it is possible to produce powerful waves three feet in height. This wave motion not only increases the pleasure of the bath, but presents a sanitary advantage as, according to Dr. Brieger, it effects a mechanical destruction of bacteria; it also affords an opportunity for practice in swimming in rough water which is a valuable acquirement.

Such a swimming tank, measuring 40 by 130 feet, with its shed, etc., can be constructed for about $20,000.

Everyday Misnomers

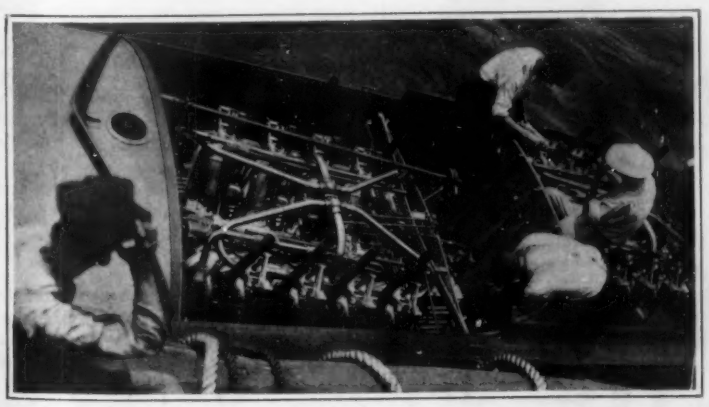
A VAST number of incorrect notions are acquired by reason of misleading names. For instance, we ask for a Dutch clock. We get the kind we want, so it really doesn't matter that it is not a Dutch clock at all, but one of German manufacture. Practically all the wooden clocks called Dutch are made in the village of Freyburg, in the Black Forest. This misnomer is due to simple mispronunciation—"Deutsch" meaning, of course, German.

Nothing is more natural than to assume that India ink comes from India, but it does not, and never did, any more than does India rubber. India ink is a Chinese product, and India rubber comes from South America.

Camel's hair brushes are not made from the hair of camels, but from the hair of the tails of Russian and Siberian squirrels. Camel's hair is, however, employed in the manufacture of certain fabrics to be made into shawls, etc., and it is sometimes mixed with silk.

French brier pipes are not made from the roots of brier, but from the root of a white heath which attains a considerable size in the south of France, where it is sedulously cultivated for pipemaking purposes. The name is derived from the French bruyère, the dialect form of which is brière, meaning heath.

We entertain a fixed idea that a centipede has 100 feet, and naturally, but we are misled by the name. As a matter of fact, this insect, taking one of the largest species, shows about thirty feet on each side.



The two 250-horse-power 8-cylinder V-type Crane motors in "Dixie IV."

The single-step hydroplane "Dixie IV." going at half speed.

THE WINNING BOATS AND ENGINES IN THE HARMSWORTH CUP RACE

Curiosities of Science and Invention

Seventy Automobiles Crossing the English Channel

THE recent Prince Henry Race placed navigation before an interesting task, viz., loading on a passenger steamer within a few hours no less than 70 automobiles, and taking these cars with their drivers, their owners and their families, across the Channel to Southampton, whence the race was to be continued through England and Scotland.

Most elaborate plans were required to carry out this transport. The number and kinds of cars to be stowed in the various holds of the ship had to be accurately ascertained beforehand, so as to avoid any hitch. As the small hatches generally used on passenger steamers were likely to afford difficulty in transferring the automobiles, special loading means had to be devised for loading the cars. A platform was built with two iron brackets bent upward at one end. This was suspended from the crane so that it could be adjusted to any inclination, thereby reducing the horizontal component sufficiently to provide admission to the hatch. The front wheels of the cars rested against a beam on which sand bags had been arranged for protecting the tires. Adjustable guides at each side protected the cars against any lateral motion. The loading of the cars was effected without any hitch or damage in about six hours, which is the more remarkable as the irregular arrival of the cars resulted in loss of time. The unloading at Southampton also took six hours.

No further difficulty was experienced in stowing the cars in the holds and decks; those located on wooden decks were propped by pieces of timber nailed to the deck, and those standing on iron decks, by sand bags slipped in front of the wheels.

The unloading at Southampton was likewise performed without any hitch and with the exclusive use of the ship's own hoisting devices within six hours. Immediately after the landing of the cars, their gasoline tanks were filled. The cars were then submitted to a thorough cleaning, and the race was continued on English soil.

Shipping seventy automobiles.

Tipping a car to enter a hatch.

A Stranded School of Whales

ON an island off the northwest coast of Tasmania, near the entrance to Duck River, thirty-seven sperm whales were stranded early this year. How they came to be driven ashore is not known. We can imagine them panic-stricken and stampeding like a herd of bison, but more probably they were driven by hunger and followed a small shoal of fishes, pursuing them into dangerously shallow water at high tide, where they were stranded when the water receded. Whatever the cause, the whales were driven far up on the sands, and being unable to work their way back into water, soon perished. They were discovered by the captain of a ketch who knew that there were whales about by the oiliness of the water and the stench. The stranding of so large a school of whales is decidedly unusual, and many excursions to the island have been made by sight-seers as well as hunters of whalebone, ambergris and spermaceti. Even the novice will recognize these whales with their enormous blunt heads and narrow toothed jaws as belonging to the sperm or cachalot species.

Thirty-seven whales stranded off Tasmania.

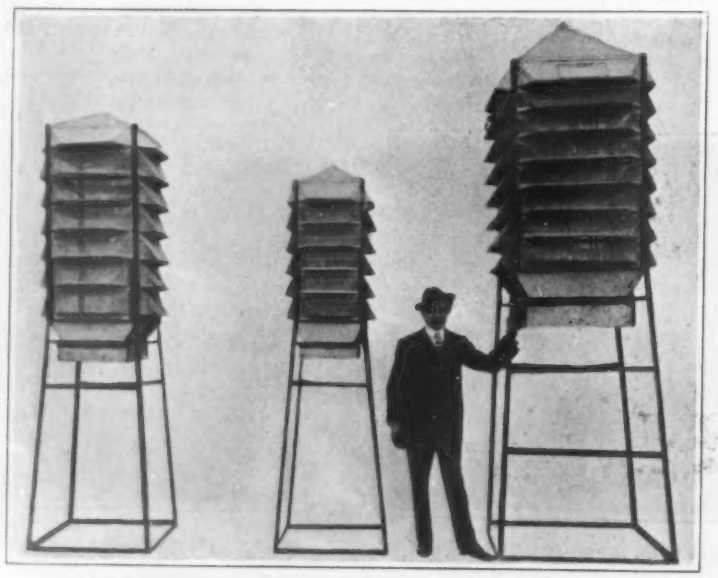
Flower-picking Apparatus

THE accompanying illustration shows an apparatus for plucking flowers and collecting seed, which is intended to save a good deal of labor in the garden. The apparatus consists of a tube connected with a pair of shears. At the forward end of the tube is a fork, which is slipped under the flowers. The blossoms imprisoned between the prongs are severed by a blade traveling upon the fork and are dropped through the tube into a receptacle at the rear of the apparatus. The device not only collects flowers very quickly, but also without injury. When the flowers are plucked by hand it is almost impossible to break a twig without leaving behind a long sliver of bark. Sometimes even a whole plant must be torn up by the roots. The apparatus can also be employed for collecting seed capsules which are often crushed when picked by hand so that the seed is lost. The entire capsule drops uninjured into the receptacle at the rear, so that the seed is preserved.

An apparatus for picking flowers and seed.

Fighting Moths in Egypt

IN order to increase their collections of insects, two entomologists, Messrs. Andres and Maire, of Alexandria, Egypt, tried to improve upon the fermented liquids commonly used for the purpose of attracting insects. Their experiments proved exceedingly successful, and in 1908 they used them to catch the injurious moths that infest the cotton fields. For their first trials, they employed bands of jute cloth, four inches wide and about sixteen feet long, soaked in the mixture, and hung on posts where the wind would carry the scent over the cotton fields. Moths were attracted by the hundreds, and, by means of chloriform, they were stupefied, so that they dropped into vessels of water. As this method of procedure was not commercially practical, the inventors devised traps in which the insects could be caught. A set of these traps is shown in the accompanying engraving. They are made of bands of galvanized wire gauze placed in a slanting position, with a very narrow opening between the bands to admit the moths. Within these traps the cloth strips are hung. The moths feed on the liquor soaked in the cloth strips, and drop into vessels of kerosene, at the bottom. As many as five thousand moths have been caught in one of these traps in a single night. The success of these experiments has resulted in the use of a great many moth traps and the catches are counted by thousands, greatly reducing the hand-picking labor. When the traps are used all over the country, it is expected that the pest will disappear from Egypt. The same type of trap is now being tried in France by the wine-growers, who are fighting the moth known as *Cochylis*.



Traps for the moths that infest Egyptian cotton fields.

When the Smoke Nuisance is Punishable

"THE man who built his factory some years ago, when architects were in the habit of forgetting to provide the necessary space, and engineers were therefore unable to install boilers adequate for the work to be done, is entitled to some sympathy when he falls into the clutches of the present-day smoke abatement laws—though even in these cases the nuisance can usually be abated at little cost. But the man who to-day, with all its improved knowledge and appliances and practices in sight, erects and operates a smoke-producing heating or power plant should be promptly stopped and punished as the creator of a public nuisance as unnecessary as it is disagreeable and injurious."—*Dr. Holmes.*

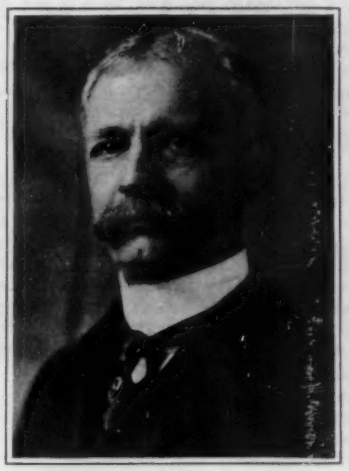
Aeroplanes in War.—For the first time in Germany aeroplanes will participate in the army maneuvers to be held near Altona, beginning the 25th inst. Heretofore only dirigibles have participated in the German maneuvers, but the results with these were so poor last year that the Emperor has decided to try aeroplanes.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

Dr. M. Dorset, biochemist of the Bureau of Animal Industry. He discovered an absolute cure for hog cholera.

Brig.-Gen. A. R. Buffington. Joint inventor of the mounting for our twelve-inch disappearing guns.



Brig.-Gen. W. Crozier, joint inventor of the mounting for our twelve-inch disappearing guns.

Dr. J. W. T. Duvel, who discovered a standard method for determining the moisture in grain.

Inventing for the Public

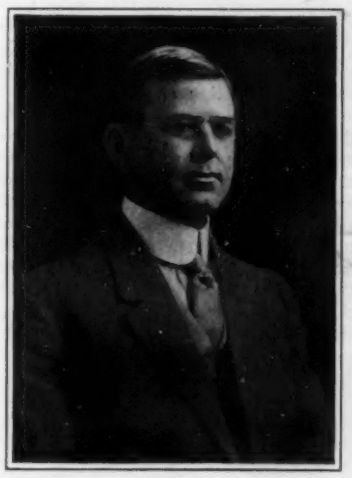
Government Inventors Who Have Given Their Patents Away

By William Atherton Du Puy

THERE is an unwritten law in the government service which stipulates that he who, while drawing a salary from Uncle Sam, makes an invention, shall demand no royalties upon it but shall dedicate it freely to the public. This unwritten law has not always controlled. It was much more often disregarded in the past than in the present. In the history of the government service there are a number of instances of men connected with it who have made inventions from which they have made great fortunes. These instances are, however, growing more infrequent all the time. They were always greatly in the minority. Of the 250 patents that have been issued by the Patent Office to government employees, not ten per cent have been kept from the public. The idea of profiting by his own invention has practically been given over by the government employee and the exercise of his inventive genius is now almost entirely patriotic.

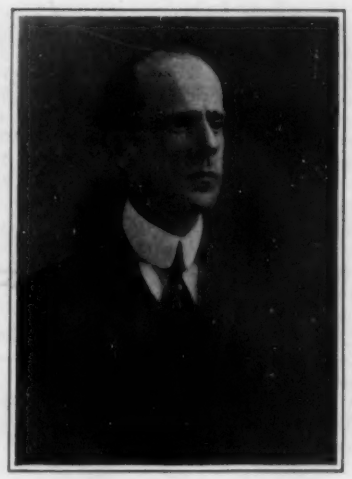
Yet this need not be true under the law. There is no law which stipulates that the government employee may not profit by his inventions, whether made on government time or in private. Should the government employee inventor see fit to demand the right to his invention there is no law which refuses him whatever profit he may derive from it. Court decisions in general practice take the view that when an employee takes out a patent the subject matter of which is in general line of his employment, there is an implied license of the employer to use the patent. Upon this basis a feeling grew that the government had a right to use the patents of its employees. This idea went still further, upon the theory that the public was the employer, and the practice grew up of giving these inventions freely to the public. The Secretary of Agriculture has gone so far as to issue a general order in which he requires employees making useful inventions to dedicate them to the public.

This view of the matter has been generally accepted in the government service. There are many inventions that might have made their originators wealthy that have thus been surrendered. There are many others that are merely useful and economical to the government, saving it thousands of dollars a year, which it accepts from employees and for which it recompenses them in no way. The Bureau of Corporations was some time ago asked by Congress for an opinion on the status of the inventor in the government service and the government's claim upon his invention. That report stated that the present attitude of the government tended to discourage invention and held that government service would be improved if inventors were allowed to profit by their patents, being thus encouraged to make inventions along the lines of their work.



L. W. Page, director of the Office of Good Roads, inventor of a waterproof cement.

But this is not the present practice. When a man in the government service to-day makes an invention he dedicates the free use of it to the government and to the people of the United States. He has one chance of making money out of it and that is through a sale of foreign rights. Neither practice nor public opinion denies him this. It would seem that there would be little reason why a government employee inventor should take out a patent, if he is not to profit by it after all, but his case is peculiar. He is usually a scientist, devoting his life to a given line of work and to the service of the public. His invention has something to do with his work and with its effect on the public. He is anxious that the public should profit by his work. If his invention is of any value and he fails to patent it, there is the chance at any time that somebody else may take out the patent and collect royalties from the public. The actual effect of his taking out the patents and giving them to the government and to the public is to prevent some more mercenary individual from collecting royalties. These patents are for the protection of the public rather than for the protection of the patentee.



J. E. W. Tracy, inventor of a packet-filling device used in distributing seeds.

Among the newest of the patents that appear to be of great importance to the people is that of waterproof cement, for which letters patent have been issued to Logan W. Page, director of the Office of Good Roads, Department of Agriculture. This cement is made by mixing oil with the ordinary cements. The principle also applies to mortars and concretes. It produces a cement that, in the first place, will hold water and may be used for such structures as water tanks. Concretes that are otherwise easily penetrated by water become waterproof. A lining of waterproof cement or concrete will make an otherwise porous structure water tight.

Last May streets were constructed of oil mixed concrete, one in New York city, one in Washington, and two bridge surfaces in Ridgewood, N. J. A few months ago a vault 105 feet long by 18 feet wide was constructed of this material in the Treasury Department. The top was a flat reinforced concrete arch and as sufficient tests in bond had not been made, ordinary concrete was used to surround the reinforcement. After it had set, three inches of a ten per cent oil mixture was placed above. The vault has been perfectly waterproof under very trying conditions. A large water tank, constructed in the good roads laboratory with a ten per cent oil mixture, is absolutely waterproof. Extensive experiments made with oil concrete in basement floors have given excellent results up to the present time. No moisture enters the walls of houses built of this waterproof. Water poured on a basement floor made of it will roll up in globules instead of entering the cement. Col. Goethals is experimenting with it as a material for building locks. It promises to find extensive use in the building trades.

Mr. Page patented his product and two methods of making it. The demand for the material already indicates that there would have been millions in the patents if privately handled.

Dr. Marion Dorset, biochemist of the Bureau of Animal Industry, is a young scientist of great inventive genius. He it was who first found the germ that is responsible for cholera in hogs. This germ is so small that the most powerful microscopes cannot detect it nor can the most delicate filters remove it from water. Dr. Dorset, having isolated the bacteria, invented a serum with which to combat it. The serum and the processes of manufacturing it were protected by patents.

Hog cholera was causing a loss of $15,000,000 a year in the United States. When the disease broke out in any locality it went on and on with no power to oppose it. But the serum which Dr. Dorset patented is an absolute antitoxin. He has repeatedly proven its effects. He has, time after time, taken a given number of pigs, inoculated half the number, and put

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them all in a pen with infected pigs. All of those not inoculated always die and not one that has been treated is affected. It is one of the most absolute antitoxins known to science.

When hog cholera now breaks out in a given locality, all the animals thereabout are inoculated. The outbreak soon wears out for lack of material upon which to feed. An application of the cure with a moderate degree of efficiency results in the saving to the nation of $15,000,000 a year, and this amount would reach considerable proportions in even the span of one man's life.

Dr. Dorset is also the inventor of a secret ink used by the government in stamping meats which have been passed upon by the government inspectors at the packing houses. There was formerly in use in marking these meats a tag that was patented by a private firm. These tags were costing the government about $60,000 a year and were not nearly as effective as the ink which puts the stamp into the meat itself. Dr. Dorset's ink is not patented. The secret of its manufacture can be more effectually kept through not patenting it. The method of applying it to the meat and the devises used in the process, however, are covered by a government patent and in this way the process is doubly protected.

Despite the invention of a hog cholera serum, which saves the people $15,000,000 a year, and the ink which saves the department $60,000 a year direct, this young scientist receives but $3,500 as an annual stipend. He is the sort of man, however, who is more interested in his work than in money, and is entirely satisfied.

J. W. T. Duvel is the government's specialist on grain standardization. It was in connection with this work that he found there was a variation in the weight of grain from five per cent to twenty-five per cent, due to the amount of moisture it contained. Obviously this moisture content should be reckoned in selling grain. Dr. Duvel invented a moisture tester that is now in use in most of the elevators of the nation but from which he has never received a cent in royalties.

The scheme for ascertaining the amount of moisture a given sample of grain may contain is based upon the possibility, under certain conditions, of boiling it off and then condensing it. A given sample of grain is carefully weighed. Then it is placed in oil that has a boiling point a great deal higher than that of water. It is heated to a temperature where the water in the grain goes off in vapor. This vapor is recondensed and carefully weighed. Its weight in proportion to the grain from which it came is the percentage of moisture in the given grain. With Dr. Duvel's device the test may be made in a very few minutes. The same principle, under another patent, is applied to a test of the amount of water in butter.

Joseph L. Harley, an employee of the Bureau of Engraving and Printing, is the patentee of a so-called "press register." This device, when attached to a press, records every impression that is made from it. In the Bureau of Engraving and Printing there are five hundred presses that are used in printing the money, and the postage and internal revenue stamps of the government. This registering of the number of impressions that are made from a given press serves as a check and precludes any possibility of printing money or stamps that are not accounted for. It has been in use by the government for many years and Mr. Harley has never received any compensation for it.

C. R. McBlair, an employee of the Supervising Architect's office, is the patentee of a photographic process which is used in duplicating designs made in that office. The Supervising Architect and Mr. McBlair have both signed a statement to the effect that from $5,000 to $8,000 a year is saved the government through the use of this invention. Yet no royalties are paid to the inventor.

Brig. Gen. William Crozier and Brig. Gen. A. R. Buffington, U. S. A., are the patentees of a mounting for the great twelve-inch disappearing guns, commonly in use in the army. So heavy and so complicated are these devices that it costs $45,000 to manufacture one of them. The records of the Chief of Ordnance, however, show that 395 such gun carriages, embodying features covered by this patent, have been used by the government. No royalties, however, have been paid for this use. The letters patent taken out by these army men state that: "We hereby dedicate to the government of the United States the free right to use, to make, and to have made in the United States for its own use, gun mountings embodying this invention." This procedure is somewhat unusual in the army and navy for, in those services there has been a much stronger tendency on the part of inventors to insist upon profiting through their patents.

B. L. Andrus, superintendent of the mail lock repair shop of the Post Office Department, is the inventor of a conical pointed grommet which is used extensively in all the registered mail work and in ordinary mail sacks and pouches of the government. Officials of the Post Office Department admit that this invention would have been a bargain had the government bought it outright for $10,000. There are, in the Postal Service, a great many of these smaller inventions which are not applicable to any other use but which are of great value to that service. Many of these have been patented for the protection of the government against the same action on the part of outsiders. The inventors have, however, received no profit from them.

J. E. W. Tracy, of the Bureau of Plant Industry, is the patentee of a device for the automatic filling of all those seed packets which members of Congress frank to constituents throughout the country. The use of this machine makes it possible for the government to secure competitive bids for putting up seeds. The inventors and owners of other practicable machines state that it is worth $1.32 a thousand packets to do this work. This machine enables the government to save at least three cents per thousand on its packets. As approximately 37,000,000 packets are filled annually, the Tracy patent secured a saving of about $3,700 a year to the government. The inventor, however, in no way profits through this saving.

Probably the most complicated machine that has ever been invented by a government employee is one in use at the Coast and Geodetic Survey, and upon which may be automatically figured the time and degree of maximum and minimum tides at any time or place. A very important phase of the work of the Coast and Geodetic Survey is the forecasting of tides and the making of charts recording those forecasts. The computation of the time of high tide or low ebb for a given place is a very complicated process and there are nineteen different elements entering into the calculation. This tide predicting machine takes all those elements into consideration and, with a single operator, automatically gives the answer. To produce the same result with the same degree of accuracy without the use of the machine would require thirty computers, working throughout the year. On a salary basis of $1,000 each, there would be expended each year in hiring these computers, a total of $30,000. William Farrel was an employee of the Coast and Geodetic Survey when, thirty years ago, he devised this complicated machine. He freely gave his invention to the government and never in any way profited from it. Upon this machine the tide forecasts have been calculated since 1883.

Such are a few examples of the hundreds of patents that have been issued to people in the government service and for which they have received no remuneration. That the law does not require their surrender to the government and that they have been none the less voluntarily given over, speaks volumes for the patriotism of the men who are spending their lives in the service of Uncle Sam on a fixed salary.

Notes for Inventors

Harvester Patents.—In a letter in rebuttal of the Report, made by the Hon. A. O. Stanley, Chairman, and a member of the House Committee on Investigation of the United States Steel Corporation Mr. Edgar A. Bancroft, general counsel of the International Harvester Company, conveys some interesting information on the harvester patents. "The knotting device was patented by Appleby in 1879," according to Mr. Bancroft, "and there has been no radical change in the knotting device or in the general type of the self-binder since 1891. Inasmuch as there are no patents on the essential parts of the self-binder in existence, a fifty million dollar corporation has this year put out 500 binders, the Minnesota State Prison has sold 650 binders and a well-known thresher company has made an experimental binder. . . . . The charge that the company furnishes no incentive to improvements in these machines is equally erroneous. On the contrary, it maintains a large and active staff of inventors, experimenters and inspectors—far larger than ever existed before—at an annual cost of over $350,000; and it has added many improvements to the machines, and has greatly increased their efficiency and durability."

A Sailor's Invention.—Luke McNamee, of the United States Navy, has secured a patent, No. 1,000,834, for a shock absorber for searchlights. The door of the searchlight is cushioned by means of springs which hold the door out of contact with the body of the searchlight in such manner as to permit the pressure on each side of the door to be equalized and absorb the shocks incident to gun fire.

Another Dedicated Patent.—Logan Waller Page, of the division of good roads of the United States Agricultural Department, has secured and dedicated to the public a patent, No. 1,000,545, for a cement concrete and method of mixing and preparing the same. The method consists in adding to an ordinary cement and water mixture, a quantity of non-volatile mineral oil. The oil is added before the cement begins to set and the quantity of oil used does not exceed twenty-five per cent of the cement.

A New Biscuit.—A biscuit, having an inner mass of starchy and brittle filaments surrounded by a tougher covering of glutinous filaments which have a binding connection in which the ends of the inner filaments are secured, has been patented, No. 1,000,357, to Edward W. Anderson of Washington, D. C.

Death of William D. Sargent.—William D. Sargent, who is said to have associated with Alexander Graham Bell in the telephone matter, died on August 10th, at his summer home in Somerset, Pa., after an illness of several weeks following an automobile trip from his home in Brooklyn. Mr. Sargent was one of the old time telegraphers and a member of the United States Military Telegraph Corps Society and was also well known in the financial circles of New York and Brooklyn.

Destruction of Rats.—An East Africa publication contains a description of a method of destroying rats, followed in Java, in which carbon bisulphide is employed. In carrying out the method a small quantity, usually about half a teaspoonful of the carbon bisulphide is poured into the rat hole and after waiting a few moments to let the liquid evaporate, the mixture of air and vapor is lighted, a small explosion resulting and filling the hole with poisonous gas, killing the rats instantly. Such a process practiced openly might be objectionable under some circumstances because of danger from fire resulting from the explosion and a field for invention appears to offer itself to provide some form of fire-proof gun or explosion chamber suitably formed to be inserted in the mouth of the rat hole and adapted to enclose the explosion and discharge the resulting noxious gas into the hole.

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If you use drawings, sketches, blue prints, etc., in your work, the "Search Party" illustration below tells a very familiar story.

You want a certain drawing or map, we'll say; you saw it in your office just last week. You send a boy for it; he looks and

"The Search Party"

hunts everywhere. You have a customer, or prospect waiting, or perhaps your Chief has asked for the print. Anyway, important affairs hinge on the finding of it.

You may go through the whole pile; lose time, temper, and maybe your Chief's respect for your managing ability, or a possible customer.

After sweating blood for 20 minutes you may find it. And probably it is badly torn, dusty and frazzled. Even if it is in good condition, *you couldn't find it when you wanted it.*

If drawings are worth keeping they are worth keeping right. Why not keep them clean and flat and indexed so you can locate any one in a jiffy?

The Solution

"Y and E" Vertical Blue Print Cabinet No. 430, carried in stock. Table front when extended can be used as reference shelf or drawing board. It is dust proof; drawings are kept flat, clean and smooth; indexed for quick reference.

In the "Y and E" Vertical Blue Print Cabinet, shown here, you can file 700 to 1,000 prints, indexed for instant reference. The cabinet is dust proof; takes up but 3¾ sq. ft. of floor space. The front is perfectly smooth and may be used as a handy reference table on which to examine contents or make memoranda or corrections.

Its History

Two or three years ago D. J. Burlingame, of Chicago, designed and patented a special cabinet for filing large prints in the Chicago Association of Commerce. Today we control the rights, and have changed and improved the cabinet until it is the finest on the market. It is truly the proper place for blue prints and drawings. See it and you'll agree.

Drawings can be removed from the cabinet without extending table front.

The Manila Pocket

Drawings are filed in roomy manila pockets, suspended from the top. Imagine a big vertical file, and there you have it.

The drawings are filed in manila pockets which are like big vertical folders. They are closed half way up so prints are held in place, preventing torn edges, etc. Pockets are supported by strips of hard wood fastened at the top. Mighty handy.

How to Index

One big advantage of this cabinet is the ease and facility of locating a drawing when filed. On the inner side of the cover are eight cards (printed both sides) held in permanent metal racks. Cards are ruled for easy writing of index information, and each bears letters, A-B, etc. In stock cabinets the envelopes are numbered 1 to 20. If you are filing Mr. Brown's drawings in pocket 20, you'd write under B—"Brown—house drawings—20."

What Could Be Simpler?

Contractors file blue prints, rough drawings and sketches.

Engineers file their big prints and sketches.

Art Stores file prints, valuable sketches; index by artist's name or subject.

The indexing is so easy, simple and convenient.

Draft Departments of Manufacturing Concerns file drawings and prints of machinery and other equipment; the cabinet gives it quick reference.

Chamber of Commerce—Industrial departments file city maps, sectional plats, etc.

Advertising Departments, Advertising Agents can use this cabinet to file large photos and drawings.

These cabinets are used in many other lines of work. If you have maps, drawings, prints, etc., to file you need one, too.

What One User Says

Our "Y and E" Vertical Blue Print Cabinet is entirely satisfactory. For the purpose of keeping blue prints, maps and other papers free from dust and so indexed that they can be found instantly when needed, we don't believe this cabinet can be surpassed.

W. R. HUMPHREY,
Industrial Commissioner,
The Chicago Association of Commerce.

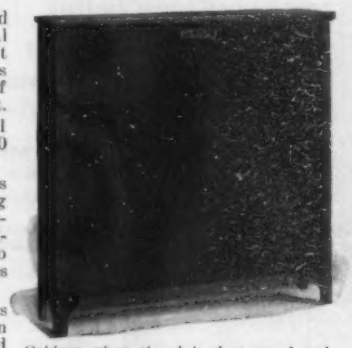
In a Nutshell

1—"Y and E" Vertical Blue Print Cabinet is dust-proof and air-tight.

2—Will hold 700-1000 prints.

3—Contains 20 strong manila pockets, suspended by two wood pieces at top.

4—Prints are filed in pockets and thus kept clean, flat and smooth.



Cabinet when closed is dust proof and compact; takes up minimum of floor space.

5—All Prints are carefully indexed by name or number, as preferred.

6—Any print quickly findable by referring to index on inside of cover.

7—Handiest known way of filing and indexing drawings, tracings, blue prints, sketches, maps, artist proofs, etc.

8—Widely used by architects, contractors, superintendents, engineers and draughtsmen.

9—Cabinets are carried in stock in two sizes—No. 036 for drawings 40x36 or less, and No. 430 for drawings 44x30 or less—and in quartered and plain oak in "Y" and "E" standard golden finish.

10—Cabinets of special sizes and in special finishes furnished to order. Estimates on request. (Advise drawing size and quantity to be filed.)

Complete Booklet Free

For your convenience, we have prepared a handy, pocket size booklet which gives full details and information about this handy cabinet. It is yours for the asking. Mail the coupon now. It is handy for immediate action.

HANDY COUPON

Send me your illustrated booklet on your Vertical Blue Print Cabinet, No. 2139A. Also, send me information about filing following records:

.....

Name.....

Street.....

City..... State.....

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BOSTON, 68 Franklin Street
WASHINGTON, 614 Twelfth Street, N.W.

BRANCHES:

CLEVELAND, 611 Superior Ave., N. E.
PHILADELPHIA, 914 Walnut Street

PITTSBURGH, 723 Liberty Avenue
BUFFALO, 213 Ellicott Square
SAN FRANCISCO, 712-16 Mission Street
LOS ANGELES, 420½ S. Broadway

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Your steam-fitter will tell you just what Pierce Boiler your house needs, and the cost.

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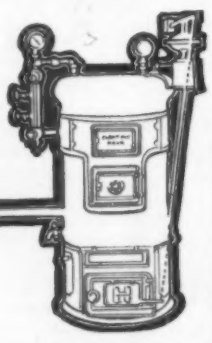

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Be sure to send for our HEAT PRIMER

It's free and it's just the kind of information you ought to have; presented in simple, non-technical language. Send for it.

There is a Pierce Boiler exactly suited to your needs. This is the "Modern," one of 200 styles.

A safe, very brilliant, powerful, steady, white light. Is better than electricity or acetylene and cheaper than kerosene.

Every lamp is a complete self-contained miniature light works.

Clean—bright—odorless—portable. Made in over 200 styles for every purpose. Fully guaranteed. Catalog free. Agents wanted.

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Walnut and 13th Sts.

Ideally located in the center of business and social life

335 Rooms — 275 Baths

Rooms $2.00 per day up
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Suites of 2 to 6 Rooms

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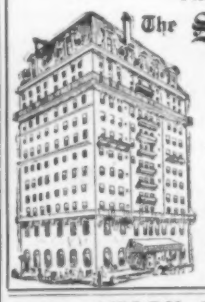

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USE THE OTHER SIDE OF THIS SPOT.
SEE PAGE 259.

¶ A HOME-MADE 100-MILE WIRELESS TELEGRAPH SET

Read Scientific American Supplement 1605 for a thorough, clear description, by A. Frederick Collins. Numerous adequate diagrams accompany the text. Price, 10 cents, by mail. Order from your newsdealer or Munn & Co., Inc., 361 Broadway, N.Y.

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Until You Investigate The Temple Make. Its Great Advantages are: 1st—Lowest Fuel Cost: pays for itself in Fuel Saving. 2nd—Delivers Steadiest Power Stream, adapting it especially for operating farm machinery. 3rd—Easy on the machine it operates. 4th—Uses Gasoline, Kerosene or Gas. 5th—Perfect Lubrication. 6th—Starts Easily and Quickly, occupying minimum space. 7th—It is the King of Portable Engines. No engine has so wide a range of use. You will make a mistake if you do not write for information. We make 1½ to 5½ H. P. single cylinder engines; 6 to 20 H. P. two cylinder engines; 30 to 50 H. P. four cylinder engines. All heavy duty, slow speed engines. For surety of operation and low fuel cost our engines lead. Temple Pump Co., Manufacturers, 439 West 15th St., Chicago, U. S. A. This is our 59th year.

Testing Before Buying

(Concluded from page 247.)

1909-1910, 19,885,217 pounds of silk were conditioned, and in the Lyons house 11,278,662 pounds. The moisture in silk varies with the climate and the morals of the seller. The normal amount is about eleven per cent. A moist situation can increase this three per cent or more. If in all the above stated American importations two per cent of excess moisture was paid for as silk, the loss to the buyers was over one million dollars. It is probable that all the conditioning houses of Europe receive as much as $500,000 for fees for services in thus examining raw silk.

But undoubtedly the largest patronage of the materials laboratories comes from the constructional industries. In these it is now quite generally recognized that the proper control of materials by specification and testing is a species of insurance upon the finished property. Considered thus the cost would be but one or two per cent of the material in place; but this percentage of cost is not charged annually as the fire insurance, but only once, and its beneficial influence endures for the lifetime of the structure. Moreover, a moral and legal value adheres in a work which, during its progress, has the reputation and proofs of being constructed only of carefully examined materials.

Chance of failure from defective material is reduced to a minimum, and if it does occur from other causes the possession of these proofs is invaluable. Not to be despised even by the financier are the æsthetic values.

In our own times architects in congested centers of population would seem to have entered upon an era that is unlike any of the past, and one that has inaugurated a school of its own. Whether this influence will persist, whether it will develop into more noble and ideal forms, more lasting monuments, must rest with the technologists who study materials and adapt them for the use of architects, and also with the latter as they grasp and utilize the knowledge. If this is not done we shall have early ruin, discouragement, defeat and a return to the more undoubted stability, if not beauty and usefulness, of the stone age of architecture.

Cast iron has been eliminated from our columnar structures; the steel used is carefully examined to insure the best quality, and the covering paints are chosen to secure the best protective value. Stone, tiling and impervious substances are sought for to protect the facades and roofs, but all of these materials have defects which research will conquer if the demand becomes insistent enough to bring the rewards.

When our laboratories of standards and of research founded by the government or by private wealth shall have been in operation a longer time, and the observers more numerous and more skilled, when international comparisons and exchanges of data shall be more frequent and general than now, the progress in these arts will be more rapid and beauty will spring from utility. We shall see these sciences which the æsthete sometimes considers of secondary importance really bringing about a restoration of beauty. This will be not alone by mere adornment and charm of variety caused by a wider choice of form and color, but most importantly by inspiring the pleasure that springs both from an impression of stability and grandeur and from contemplation of a work that harmonizes lightness with stability and fitness with gracefulness. Beauty, in fact, is a result we can long for and justly expect from these studies, not only beauty in architecture, but in the mural and sculptural arts, in textiles and in most products of human skill and handiwork. Then we shall enjoy our surroundings the more, for, as Ruskin has said, beauty has been appointed by the Deity to be one of the elements by which the human soul is continuously sustained.

Catalysis

(Concluded from page 248.)

proportion of one to two, and the interest on capital invested in the plant and in the materials locked up in the process is diminished in the same proportion. It is true that from the gain thus obtained we must deduct the interest on the catalytic material locked up in the process. Where this material is costly, as for example in the platinum contact process for sulphuric acid, this item may be considerable.

In other instances, the chief advantage gained by the use of a suitable catalyzer is greater simplicity of working and more compact disposition of the plant, or a higher quality of product. An example of this kind is the modern contact process for the manufacture of sulphuric acid, which gives directly a pure acid of high concentration in a plant rather more compact than that of the old chamber process, even though the careful purification of the gases required in the new process calls for quite extensive apparatus.

It would require a special article to do justice to this most interesting and important process, which represents one of the most striking applications of catalysis that have occurred in technical chemistry within the last few decades. In a brief survey of the general field of catalysis such as this article is intended to present, it is impossible to go into technical details, but one brief digression may be permitted, to bring before the reader an illustration of a recent development in the technique of the contact process, especially as the principles involved have been discussed in these pages in relation to operations in an entirely different field of applied science. The contact process, as distinguished from the chamber process, produces anhydrous sulphur trioxide, which is not ordinarily placed upon the market as such, but is converted into sulphuric acid by hydration. To the uninitiated it might appear that this hydration should be the easiest of all operations, inasmuch as it is well known to the first year's student in chemistry that SO_3 possesses extreme avidity for water. In practice, however, it is found, that unless special precautions are taken, when the trioxide comes in contact with the absorbing bath, dense white fumes of sulphuric acid mist are formed, which are extremely difficult to condense. The reader may recall Sir Oliver Lodge's experiments on the dissipation of fogs by means of electrical discharges. Prof. F. G. Cottrell of the University of California has taken up a line of experiment following in the steps of Lodge, with a view to condensing acid fumes such as occur in various industrial processes, notably the sulphuric acid contact process. By the courtesy of Prof. Cottrell and the editor of the *Journal of Industrial Chemistry*, I am enabled to reproduce here some photographs of an experimental installation for the condensation of sulphuric acid mist. The first picture (page 248) shows the apparatus with the gases from a converter passing through it untreated. The second picture shows the effect produced upon turning on the electric discharge. It will be observed that the precipitation of the acid mist is practically complete.

The mystery which surrounds the true nature of catalysis is not by any means a matter of purely academic interest. Technically it is felt in the fact that there is little or no general systematic method by which we can be guided in the selection of a suitable catalyzer for a given reaction. As the result of this, the discovery of such a body is very largely a matter of accident and good fortune. A rather striking example, which well illustrates this point, is quoted by Brunck in the description which he gives us of the evolution of the industrial process for the synthesis of indigo by the Badische Anlin und Sodafabrik. In the course of this process, which represents one of the most remarkable triumphs of modern industrial chemistry, it is necessary to oxidize naphthalene to phthalic acid. This oxidation at first offered difficulties. One day, however, a batch of the material quite unexpectedly yielded with ease to what appeared to be the usual treatment. The case seemed to baffle explanation, until finally the cause of the phenomenon was discovered in a broken socket, from which a small amount of mercury had escaped, and, mingling with the reacting substances, had produced by catalysis the effect desired, the rapid oxidation of the naphthalene by the sulphuric acid.

We have spoken so far only of cataly-

The ambition of every tire maker in the world is to some day make a non-skid tire as good and as popular as the famous

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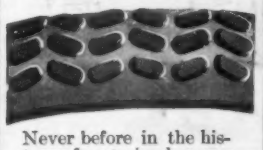

Never before in the history of motoring has any type of tire achieved such success. Everywhere, from coast to coast, Nobby Treads are replacing every other form of non-skid tire or non-skid device in every possible kind of service. And it is because the big, thick, diagonally-placed knobs grip any kind of road, no matter how slippery, and *do absolutely prevent skidding or drive-slipping.*

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Glass, nails, sharp stones are past over, never reaching your tire. These Protectors fit over any tires, any treads and are held fast by inflation pressure.

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Standard Tire Protector Company
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sis by inanimate agencies. Of the greatest importance in technical work and for vital processes are the innumerable cases of organic catalysis, or, as it is commonly termed, fermentation. For certain lower organisms have the power of catalytically bringing about various chemical decompositions. Among such organisms we number some good friends, but also some of our most insidious foes. There are bacteria which act as scavengers, converting noisome waste products not only into inorganic salts, but at the same time into plant food. Others assist certain plants in extracting from the air the inert nitrogen, "fixing" it in a form available to the plant. Bacterial fermentation produces alcohol for beverages and for industrial use. And so on, the list might be prolonged almost indefinitely. Then there are those dread visitors, the disease germs, that come upon us unseen, and, stabbing in the dark, spare neither young nor old. They, too, probably do their work by catalytic action, producing deadly poisons within our body. In the triumph of modern medicine, the keenness of our natural eye has been so far increased by the assistance of the microscope, that we can now discern these diminutive and terrible aggressors. We know something, too, of their chemical means of warfare, and are learning to fight them with their own weapons.

Let us now return for a moment to the case of the crystal "germ," which initiates the formation of the solid from the liquid, for instance in a body of super-cooled water, or in a supersaturated solution of Glauber salt. This case presents a special feature, to which attention has not so far been called: It is the product itself which acts as catalyzer, or, in technical language, the case is one of "auto-catalysis." This particular form of the phenomenon is of peculiar interest owing to its close relation to a fundamental property of living matter. This relation is clearly brought out if we consider side by side a simple case of inorganic auto-catalysis and a typical example of its organic counterpart. On the one hand, then, we have before us, say, a supersaturated solution of Glauber salt; on the other hand, a vessel containing a sterilized infusion or other material suitable as a culture medium. Each of these two systems is quite stable if left disturbed, and will retain its character indefinitely under such circumstances. But, introduce a vestige of a Glauber salt crystal into the one, or a minute quantity of a suitable bacterial germ into the other, and immediately a transformation sets in, giving rise in the first to a growth of crystals, and in the second to a growth of living matter. Furthermore, just as the same infusion is capable of producing a variety of different organisms, according to the particular germ with which it has been inoculated, so a solution supersaturated with several salts will respond to each specific crystal germ introduced by the growth of the corresponding crystalline substance. In one respect, however, the two cases seem to differ: it is quite impossible, so far as is known to-day, to cause the growth of living matter in a bacterial culture medium except by the introduction of a "germ." Only life can give rise to life, within our knowledge. In the case of the crystal growth, it is often a comparatively easy matter, when no crystal germ is available, nevertheless to start crystallization, either by increasing the degree of supersaturation of the solution (e. g. by cooling), or in some instances by mechanical agitation or analogous means. The organic chemist, however, knows that there are substances which are very refractory in resisting all attempts to crystallize them. Thus for instance, it is a rather rare occurrence for glycerine to assume the crystallized form even at very low winter temperatures. The distinction pointed out is therefore after all not so fundamental as may at first sight appear. For a more detailed discussion of this very interesting subject of the analogy between crystallization from a supersaturated solution and the origin of life, the reader may be referred to Ostwald's very stimulating series of lectures, published in English under the title of "Natural Philosophy."

For the sake of simplicity, and in or-

One of the twenty-odd White trucks owned by The Standard Oil Company

Motor Truck Advantages

THE man or firm that has a better delivery plant has an advantage. It isn't important that it saves money—that it makes a cheaper delivery—although if the right trucks are chosen, under most circumstances, it will be also more economical—but the important thing is, that the superior facilities supplied by motor vehicles gives their owner advantages—it outstrips competition—it serves the customers better. Live business men may no longer dodge the issue—motor trucks are here to stay—it's only a question of who will be first to grasp the opportunity in his line, or his town.

The Advantages of the White Truck

WHEN it comes to buying machines the best machine is cheapest no matter what it costs. Here's where White motor trucks score—everyone has heard about the white gasoline-engine design—how it foreshadowed what is accepted now as the best foreign practice and what is rapidly becoming adopted in this country by the most aggressive manufacturers. Next, each White truck is as well built as the most scientific, modern steel alloys will permit. In addition, every piece of steel is heated-treated to make White trucks as staunch as a truck may be built. The long-stroke engine makes them economical in operation—makes them efficient—the kind you must recognize as having unusual merit. White trucks may be grafted into your delivery plant completely revolutionizing its capaciy—giving it vitality without demoralizing your present force. Any bright teamster can drive a White truck, it's so simple.

May we send you a catalogue and testimonials of some of the world's largest users?

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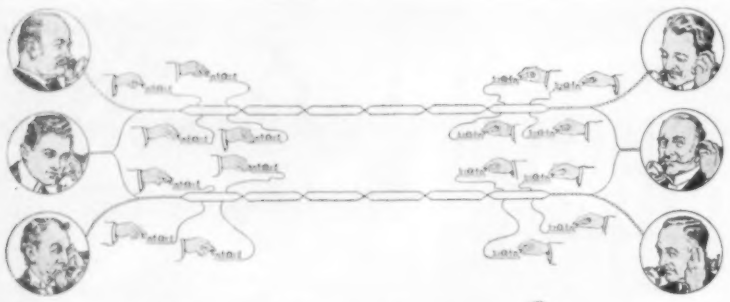

Double Tracking The Bell Highway

Two of the greatest factors in modern civilization—the telephone and telegraph—now work hand in hand. Heretofore each was a separate and distinct system and transmitted the spoken or written messages of the nation with no little degree of efficiency. Co-operation has greatly increased this efficiency.

The simple diagram above strikingly illustrates one of the mechanical advantages of co-operation. It shows that six persons can now talk over two pairs of wires *at the same time* that eight telegraph operators send eight telegrams *over the same wires.* With such joint use of equipment there is economy; without it, waste.

While there is this joint use of trunk line plant by both companies, the telephone and telegraph services are distinct and different. The telephone system furnishes a circuit and lets you do your own talking. It furnishes a highway of communication. The telegraph company, on the other hand, receives your message and then transmits and delivers it without your further attention.

The telegraph excels in carrying the big load of correspondence between distant centers of population; the telephone connects individuals, so that men, women and children can carry on direct conversations.

Already the co-operation of the Western Union and the Bell Systems has resulted in better and more economical public service. Further improvements and economies are expected, until time and distance are annihilated by the universal use of electrical transmission for written or personal communication.

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No. 78-F	Knife Sharpener—Octagonal, Stag Handle, in neat box	1.00
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Sportsmen will be interested in the book—"How the Doctor got his Pull Moose"—A true story—it's free.

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der to bring out more clearly the analogy of the crystal "germ," we have chosen for our example a bacterial growth in a simple culture medium. The phenomenon of auto-catalytic growth is, however, of course, quite general in all living matter. Indeed, Wo. Ostwald and T. B. Robertson have shown that the curve representing the rate of growth of various organisms closely resembles in character that calculated for a certain type of inorganic auto-catalytic reaction. Just how much significance is to be attached to this resemblance, is perhaps an open question. Of the general auto-catalytic character of the growth of living matter, however, there can be little doubt.

It is impossible in a short review of this kind to do justice to the entire field here broached. Much has been written on catalysis and probably still more remains to be said. For a concise *résumé*, replete with reference to the literature on the subject, the reader can probably not do better than turn to J. W. Mellor's very excellent little volume "Chemical Statics and Dynamics," one of the series of text books of physical chemistry edited by Sir William Ramsay. It is the hope of the writer that enough of the subject has been presented here to give the reader a general idea of the nature of the phenomenon and of its important bearing upon a number of questions of the highest technical and vital interest.

The Industrial Chemist.

(*Concluded from page 259.*)

For analysis of iron and coal; advantageous to know use of calorimeter.

For analyses of miscellaneous materials used in manufacturing work; position in research laboratory.

Man needed who is familiar with heat treatment of steel and metallography of steel.

Chemist experienced in analyses of iron and steel and steel products.

Young man well acquainted with food and fermentation analyses.

For regular analytical work, inclusive of mining rescue apparatus work.

Chemist to take charge of extensive salt works on the Pacific coast.

Chemical engineer to design evaporating, distilling and condensing machinery and to superintend its installation.

Chemist trained in beet sugar and agricultural chemistry. Much original research work. Thorough training required.

Good chemist, strong, of good moral habits, for medicine company.

Chemist to do experimental work in developing commercial products.

Graduate of some school of accepted standing in chemistry; analysis of oils, gums, rosins, petroleum products, pigments, coal, and boiler water. Research later if man shows ability.

Young graduate chemist for ceramic work. Must be an accurate analyst and able with proper assistance to do both chemical work and physical testing.

Laboratory chemist. Work will be mainly iron and steel.

Man familiar with the manufacturing of paint.

Experienced man for experimental work and perfection of processes.

Assistant analytical chemist; food and drug analyses.

Several young chemists for routine work on iron and steel analyses.

Instructor in mineralogy for university and analyst to department.

Energetic chemist with working knowledge of electricity with good initiative and good chemical training.

Chemist with knowledge of pharmacy, able to do analytical work.

Demonstrating chemist who understands the use of liquid chlorine for bleaching.

Several chemical engineers for factory.

Bright young man with knowledge of chemistry and bacteriology.

Chemist for research laboratory with, preferably, metallurgical training.

Chemist with some experience in manufacturing of nitre-cake and sulphate of soda.

Experienced sugar-house chemist.

Chemist for assistant in research laboratory.

Assistant chemists in laboratory.

Chemist well versed in the nitrating of cotton and the properties of amyl acetate.

Chemist for analytical tests and research work of a physical-chemical nature.

Chemist able to keep ordinary accounts and to serve as understudy to the chief chemist.

Competent man needed to take charge of manufacture of tablets, salts, and hypodermics.

Pharmaceutical chemist to take charge of laboratory; able to make fluid extracts, elixir tablets, etc.

Bacteriologist and analyst in private laboratory; to take charge of routine analyses.

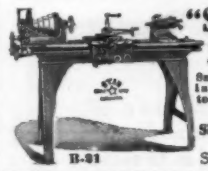
Chemist for investigation in making wood spirits of turpentine; well drilled in organic chemistry.

Photometric and testing gas analyst.

Chemist for cotton seed products and fertilizers.

These applications are for the most part for small men, and even so they do but constitute, probably, one one-thousandth part of the positions that are open to-day for competent men. And, even so, the ball has but started to roll.

It may be said, carefully and advisedly,



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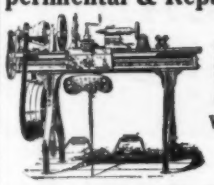

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that in the immediate future and for twenty years the demand for works chemists will far exceed the supply. The revolution in factory practice that is proceeding is the most amazing in the whole history of American industrial development. The factory of whatever type that does not possess at least one works chemist will be an anomaly.

The larger factory organizations are now rapidly establishing bureaus of research requiring the services of many chemists. It is as the heads, or chiefs, of such bureaus that men have some of the largest opportunities in contemporary industrial chemistry. Even to-day salaries of from ten to forty thousand dollars a year are being paid to chiefs of research.

Equally attractive in opportunity is the profession of consulting chemist. One of the most significant features of the International Congress of Applied Chemistry that met two years ago in London was the presence there of consulting chemists whose incomes derived from specialized knowledge in practical chemistry were princely. The man who can make himself a supreme authority even in a very limited field of industrial chemistry has limitless opportunities for achievement and of adequate reward.

Still again, a chemist, neglecting both positional and consultative work, may work simply as an inventor. In the past, such a man was almost inevitably robbed. To-day as a general rule he receives equitable treatment, particularly if he comes of good scientific antecedents.

Finally, as one of the most significant illustrations of the spread of scientific ideas in industry, there should be cited the establishment at the Universities of Pittsburgh and Kansas of the system of Industrial Fellowships. The University of Pittsburgh has received some eighty thousand dollars from various companies, the whole amount of which is to be expended in the next two years in salaries for chemist-investigators. In the University of Kansas some thirty-five thousand dollars have been involved. All this money passes out of the direct control of the donating companies for chemical investigation.

The Technically Trained Foreman

(Concluded from page 258.)

staking machine, rolling jack, glazing jack, buffing wheels, and measuring machine. Special rooms are also provided for finishing, drying and tacking. As will be noticed the equipment for this line of work is more extensive than the other. The reason for this is, that the National Association of Tanners are cooperating with the Institute in providing more extended courses in this branch of industry, which shows very clearly that our manufacturing interests realize the importance of this kind of education.

By the middle of the winter term each student has worked in all of the model factories and has finished his instruction in dyeing; so that for the remainder of the year his time is devoted entirely to that industry in which he intends to specialize.

Like all new undertakings this course of instruction has been somewhat criticised, especially by those who have not taken the trouble to investigate the methods followed and the object to be attained. It has been said that it is nonsense to teach a young man a little about soap, a little about dyeing, a little about paint, and a little about leather. This perhaps would be nonsense if it were all that the course accomplished, but such is not the case. Up to the time that the student begins to specialize it is not so much what he learns about any particular industry, but it is what he learns about operating typical machinery, handling men, assuming responsibility, and gaining self-reliance that counts. In other words, he is brought in touch with manufacturing operation, he handles material on a sufficiently large scale to produce something which has a commercial value. If through carelessness or failure to follow directions he spoils a lot of goods it means an actual loss in dollars and cents which in a factory would be very apt to cost him his job. That this method develops self confidence is evident by the pride and interest which each foreman, and his men as well, take in the product manufactured, especially when the product is of fine quality, and it is also

How to Motor Anywhere Without Asking a Question

TODAY a motorist can tour from one end of the United States to the other without asking a question as to route and without losing the road.

It is Simple and Easy—

There are today available a number of route books which give the correct speed indicator mileage at every landmark, railroad or change of direction.

All of these route books which have been adopted as "official" by the Automobile Clubs (and most of the others) have been laid out with the Warner Auto-Meter, "The Aristocrat of Speed Indicators."

Because exhaustive tests proved to the Road Map Makers that **every Warner was just like every other,** and that the mileage shown by the Map Car Warner would appear on the trip dial of *every other Warner* that ever passed that point.

Note How Touring With a Warner Works Out in Practice.

We could easily fill this space with touring experiences, all leading up to the same conclusion—hundreds of miles of absolutely unknown territory traveled without a single direction asked, even in the large cities. A couple will suffice.

The first week in June a millionaire manufacturer of Davenport, Iowa, while in Detroit, bought a popular priced car to "drive himself." The first time he ever took hold of a steering wheel was on this car, in the outskirts of Detroit. His lessons gave him the "bug" to such an extent that he determined to drive home to Davenport. So he bought an Official Route Book and a Warner and made the whole distance without asking a single question.

At Every Direction the Warner and the Route Book Corresponded Exactly.

A few days ago we met a Motor Enthusiast in Chicago en route for San Francisco with his wife and son. He had never been more than a short distance away from New York before. He had not been compelled to ask a direction up to that time—nor will he the remainder of the distance. If every owner of a car could have listened to his enthusiastic eulogy of the Warner, they would never again be satisfied with an inferior indicator.

An Exclusive Warner Refinement Which Adds Still Further to the Joys of Touring.

All Warner instruments of the dial type (see illustration) have two resetting buttons for the trip mileage figures. One resets the figures to 000.0 with a single turn. The other works on the tenths of a mile only, making it possible to turn up any desired mileage on the trip scale. This makes it possible to drive around the boulevards or through the parks at any point and then in a few seconds set the mileage back to correspond with the Route Book readings.

Those who tour regularly will appreciate this refinement.

Those Who Select Unreliable Indicators Because of Low Price are Missing the Big Joys of Motoring.

The Warner was selected for surveying the routes in these different Route Books because unvaryingly accurate and reliable. **Every Warner was found to indicate exactly the same as every other.** No two indicators of other makes indicated the same.

You should have a Warner on your car to interpret these routes for the same reason, *if you do any touring.*

If you don't tour you are missing the most fascinating part of motoring.

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The favor in which these hats are held is not a matter of chance, but of merit. Whether you pay $3.00, $4.00 or $5.00 for a von Gal made Hat, you are assured of getting the best quality that can be put into any hat at the price.

You are assured of the money's worth that only a great organization can give—assured of the styles that lead because created by the most artistic, skillful designers.

Satisfaction in the hat you wear is guaranteed to you by the dealer in von Gal made Hats. It must be to your liking. We stand behind him in this absolute guarantee.

Prices, $3, $4 and $5. At your dealer's, or if he cannot supply you, write for Fall and Winter Style Book A , and we will fill your order direct from factory if you indicate style wanted and give hat size, your height, weight and waist measure. Add 25c to cover expressage.

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"THE SPRING IS THE THING"

gratifying to note the disappointment when the product is not up to the standard, or the cost of production exceeds the price received for the finished article.

When the student begins to specialize, however, a different condition obtains, and he then does learn, not a little, but very much about that particular industry into which he hopes to enter for his life's work. It should be plainly understood that no school can turn out experienced paint makers, or expert tanners, but that the training received so fits young men that they can readily adapt themselves to the conditions encountered in the manufacturing plant.

Of the one hundred and two young men who have taken this course there are ninety-nine employed in chemical lines, of which number sixty are doing practical work. Of the latter number seventeen are employed in tanneries, sixteen in paint and color works, and the remainder are scattered throughout other lines of industry. These men hold positions as Managers, Assistant Managers, Superintendents, Assistant Superintendents, Foremen and helpers.

Although many of the graduates go into analytical lines we do not make this our aim, for we feel that that field belongs to the colleges and technical schools. The one great object which is always uppermost and for which we are constantly striving is to train young men for responsible positions in the factory, where by reason of their technical training they will be able to work more intelligently and in sympathy with the chemist, who under present conditions often finds it impossible even to try out his ideas in a practical way owing to the non-receptive attitude taken by those who have the practical work in hand.

We are a nation of vast resources and if we wish to conserve them we must improve our factory conditions. Not only must we have the trained chemist with his scientific and technical knowledge, but we must have technically trained and intelligent workmen as well. The foreman who works by rule-of-thumb is no better than a machine, but the man who uses the brains which God gave him and knows what he is doing will not only make a better product, but will be capable of grasping the details of the technical points involved.

It is the humble opinion of the writer that the time is fast approaching when all positions of responsibility will be held by men who have received a technical education, either in the university, college, technical school, trade school, or vocational institution, and especially from those schools which aim to emphasize the practical side of the technical subjects they are endeavoring to teach; for then the foreman, the superintendent, and the chemist can talk in a language familiar to them all, and the details will no longer be shrouded in mystery.

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THE present Gnôme rotating motor, which is so widely used on flying machines, is not a French invention in principle, as many suppose. In 1898 the first revolving cylinder motor made its appearance in this country, which was afterward embodied in the Adams-Farwell car.

The originators of that pioneer motor of its type have now brought out a 72-horse-power motor which revolves vertically. No carbureter is used. Gasoline is injected into each cylinder by a device which feeds exactly the same mixture to all cylinders. Hence it is possible to do away with the inlet valve and to employ one valve for both inlet and exhaust. Only air is drawn in by the suction stroke of the piston, and the gasoline is sprayed within the cylinder, where it is mixed with the charge of air before compression. The single valve in the head of the cylinder can be made amply large to insure a full charge and a free exhaust.

In order that the cam which controls the action of all five valves may be relieved from the heavy load of opening a large valve against high pressure at the time the exhaust takes place, the cylinders are provided with auxiliary exhaust ports, which are uncovered by the piston on its inward stroke. No check valves are required for these auxiliary ports. On the suction stroke, pure air,

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Go get it. Don't let corns torment you any more.

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B protects the corn, stopping the pain at once.
C wraps around the toe. It is narrowed to be comfortable.
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and not a mixture of gas, is drawn in. The air aspired through the auxiliary ports and suction stroke becomes a part of the explosive mixture in the cylinder, and since it is constant in quantity, it does not affect the operation of the motor.

The motor is controlled by regulating the amount of gasoline used. The only adjustment that may be construed as belonging to the carbureting system is the valve by which this control is accomplished.

To lubricate the motor, an oiler is employed which consists of a single rotary member, much resembling in form the cylinder of a revolver, with longitudinal chambers bored therein. Each of these chambers carries a plunger which, as the cylinder revolves, is driven from end to end by two cams, thereby causing a small amount of oil to be drawn into each of the chambers at the bottom, and ejected into a corresponding tube at the top. An extra heavy grade of cylinder oil is thus supplied to the various bearings and to the cylinders, thereby obviating the necessity of splash lubrication, which in other rotating cylinder motors calls for the flooding with a great quantity of oil, and the consequent gumming of the valves and sooting of the spark plugs.

In order to insure against the accidental stoppage of the motor, two spark plugs are provided for each cylinder, as well as two independent ignition systems.

Instead of circular flanges, longitudinal flanges are employed, as the result of a series of experiments to determine the action of the air in circulating about the cylinders of a rotating motor. Since the air is thrown off radially from the cylinder walls, it would seem that the logical arrangement of cooling ribs or flanges is that which has been adopted. There are structural advantages in placing the flanges in this way, for the cylinder is strengthened against tensile strain caused by the action of centrifugal force and the explosions.

The material of which the motor is made is vanadium chrome nickel steel. The bore is 6 inches and the stroke likewise 6 inches. The rating is 72 horsepower by the A. L. A. M. formula (square the bore, multiply by the number of cylinders, and divide by 2½). On actual propeller tests it is claimed that more power than this has been developed. Furthermore it is stated that a 9-foot 6-inch propeller, of 6 feet pitch, has been driven at 900 to 1,000 revolutions per minute.

The makers state that only one gallon of lubricating oil is used to 20 gallons of gasoline, instead of 1 to 4, or 1 to ?, which is found necessary with European motors.

Moving Pictures of the Coronation

ACCORDING to a German trade paper devoted to the interests of the moving picture industry, the activities of the moving picture makers to obtain good films of the coronation were equal to the exertions of any of the newspapers to publish the fullest and best accounts of the ceremonies. All told, we learn, fourteen firms sent 200 operators to the coronation. They were well received and had to pay heavily for good positions, as much as $1,500 in one case. It is said that not less than 10,000,000 feet of film were required, which was used up at a rate of about 200,000 feet an hour by each of the cameras.

Many of the moving picture theater owners had made arrangements to exhibit the coronation films on the very evening of the coronation itself. Some of the railroads considerately placed special trains at the disposal of the manufacturers, and thus the films reached the provinces with astonishing rapidity. The films were developed on board the trains and positives made immediately. On the very night of coronation day films were thrown upon the screens at Liverpool, Manchester, Birmingham and even in Paris. The representative of a French firm, who took passage on the "Mauretania," developed his negatives and made his positives on board. Immediately on his arrival in America he distributed his films to the various film exchanges with whom he had made arrangements.

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Oswego Serge—for men's attire depends not on fashion's whims. It is a staple fabric and worn through all seasons.

A serge suit is part of every man's wardrobe. Whether the suit be custom-made or ready-to-wear, the sterling quality of **Oswego Serge** speaks for itself. **Oswego Serge** is made by

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Oswego Serge is made in a deep, rich Navy Blue and in Black.

Oswego Serge is made of the finest wool and — quality considered — priced low.

Whether ordering a custom-made suit of your Tailor or a ready-to-wear suit of your Retail Clothier, insist on **Oswego Serge.**

If unable to obtain **Oswego Serge,** send us the name of your Tailor or Retail Clothier, accompanied by money order or check for quantity desired, at $3.00 per yard, and we will see that you are supplied. Your Tailor will do the rest. Samples furnished on request.

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TO MEET EVERY REQUIREMENT OF THE EXACTING SPORTSMAN, TOURIST OR MOTORIST

Forestry Cloth (Shade No. 65) as an out-door fabric is ideal, because dust and wind proof — sheds water — and being a beautiful shade of olive-green commends itself to the woodsmen; has been adopted by the U. S. Government as standard for the Forestry Department. Comes in several weights.

Olivaute Cloth — a fabric similar to the above in weave — made in an attractive shade of light brown and especially suited for riding and driving clothes, motorists' apparel, outing suits and raincoats.

These cloths are highest grade, pure all wool worsted, closely woven, very durable and uniform in color.

Samples of *Forestry Cloth* and Olivaute Cloth sent upon request. If you are unable to procure these fabrics from your Tailor, we will see that you are supplied upon receipt of price. When ordering specify fabric and number of yards desired. *Forestry Cloth* $2.75; Olivaute Cloth, $3.50 per yard.

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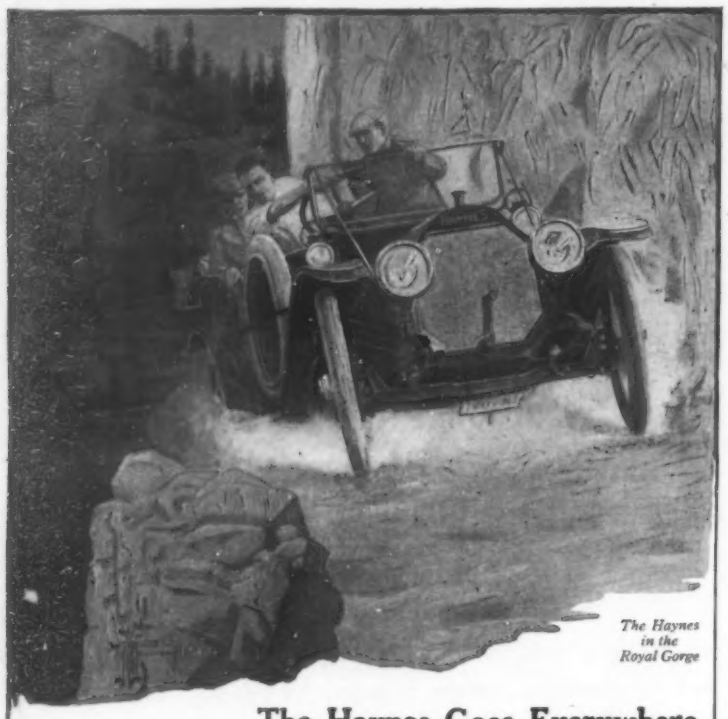

The Haynes in the Royal Gorge

The Haynes Goes Everywhere

AND the best part of it is that ever since 1893 the Haynes has been going everywhere that any automobile could go. Eighteen years of the history of automobiling are built into the 1912 Haynes. This means a whole lot to you who are considering the buying of your first automobile this year, or the buying of another to take the place of the old one that is worn out or isn't good enough.

This eighteenth year of the Haynes car is a year of triumph for the pioneer American builder of automobiles. Last year automobile experts, and the public as a whole, declared the Haynes had reached the limit of quality production at a $2100 price. It was hard to figure how any more automobile worth could be put into a car at the price of the splendid 1911 model, but there *is more* in the 1912 Haynes, and the price remains $2100.

The 1912 Haynes is not radically different from its recent predecessors. It is not radically better, but it does represent more all-'round value than *anybody* has ever before been able to put into a car selling at the Haynes price.

The 1912 Haynes is a bigger car—120-inch wheel base: it's a roomier car—wider rear seat and more depth both in the tonneau and in front; it's a more powerful car—the 4½x5½ motor gives forty to forty-five horse power; it's a safer car—larger brakes give one square inch of braking surface to every thirteen pounds of car and it is a snappier, more stylish car—the whole car is finished in black with seventeen hand-rubbed coats of paint, and the trimmings are of black enamel and nickel.

The 1912 Haynes is now ready for delivery. You can see the new models at our branches and agencies, or we will send you a catalogue and name of dealer nearest you. The line is complete, meeting every demand—5-passenger Touring, 40 h. p., $2100; 4-passenger, 40 h. p., Close-Couple, $2100; Colonial Coupe, 40 h. p., $2450; 7-passenger Touring, 50-60 h. p., $3000; 4-passenger Close-Couple, 50-60 h. p., $3000; Model 21 Limousine, 40 h. p., $2750; Model Y Limousine, 50-60 h. p., $3800. Complete regular equipment for all models is of the very highest class. Provision is made for the installation of electric lighting equipment at nominal cost. Address

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Special Trip by the superb transatlantic liner **"Kaiserin Auguste Victoria"** (25,000 tons) to **Madeira, Gibraltar, Riviera, Italy, Egypt and the Nile.** The largest and most luxurious steamer of the Hamburg-American service. Equipped with Ritz-Carlton Restaurant, Palm Garden, Gymnasium, Electric Elevators, etc.

Will leave New York, February 14th, 1912, arriving at Funchal (Madeira), **February 21st; Gibraltar, February 23d; Algiers, February 24th; Villefranche (Nice), February 25th; Genoa, February 26th; Naples, February 28th, and Port Said, March 2d.**

Returning, the **"Kaiserin Auguste Victoria"** will leave Port Said March 4th for New York, via Naples and Gibraltar.

Time for sight-seeing at each port.

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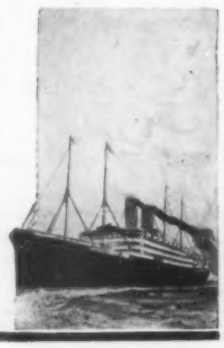

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12533) Y. R. C. asks: In "Heavens in June" in your journal of June 3rd, it was stated that we could recognize Venus and Jupiter by the fact that planets do not twinkle. This I observed to be true. But according to your explanation given in query No. 12461, that distant lights twinkle because the strata of the intervening air change their refractive powers, it should not make any difference whether the light is from a planet or a star. Will you please explain it? A. The reason given by astronomers why planets do not twinkle is that they present apparent disks, and are not mere shining points as the stars are. Mercury, the smallest planet and the nearest to the sun, is always seen to be twinkling violently. This peculiarity of Mercury among the planets is due to its small size, so small that at its great distance from us it has no apparent disk, and its greater intrinsic brightness because of its nearness to the sun. See Todd's "New Astronomy," pages 92 and 313. We can furnish the book for $1.50.

(12534) F. A. C. says: Is it true, as I have often heard stated, that dry batteries will give better results (i. e., a better spark at same voltage) than will wet batteries; both batteries being in their best condition. Is this true and why? A. A dry cell is made to have a very low internal resistance and so to give a large number of amperes on short circuit. It therefore is well adapted to give a very hot spark. If a wet cell were made on the same lines it would give the same result. It is not the voltage of the cell which produces this result, but the amperes, and this is the quotient of the volts divided by the ohms in accordance with Ohm's well-known law.

(12535) W. L. S. asks: Has an article ever been published in the SCIENTIFIC AMERICAN describing a method of hypnotizing one's self and rendering one clairvoyant? Also do you know of any source of information that could furnish the desired data? A. We have had many valuable articles on hypnotism in our SUPPLEMENT. We name numbers 148, 295, 371, 587, 720, 756, 1047, 1056. We will send these papers for ten cents each. We can also furnish you any book published upon the subject; we name Bramwell, "History, Practice, and Theory," $4.50; "Hypnotism," by Moll, $1.50; "Hypnotism, How It is Done, Its Uses and Dangers," by Cocke, $1.50.

(12536) C. R. asks: On the night of August 15th I observed a meteor in the southwestern sky which behaved different from any I ever before saw or heard of. When first noticed it appeared a considerable distance to the left and above the apparent position of the planet Jupiter. At first it followed the usual wide course, going toward the big planet across the sky. At the end of the long course the meteor turned sharply upward, its bright white light changing to a brilliant orange, quickly vanishing in a puff of black smoke. Is it customary for meteors to behave in this way? What was the cause of such apparent erratic motions? Does the SCIENTIFIC AMERICAN sell any books on astronomy that would be worth while to the novice? If so, give prices, as I want to buy. A. While it may not be said to be customary for meteors to show the changes shown by the one you describe, still every sort of behavior is found in them. Changing color and vanishing as if with a puff of smoke is not uncommon. We can supply you any book in print upon astronomy. You will find Prof. Todd's book very interesting and accurate. His "New Astronomy," price $1.50, is widely used as a text book, and his "Stars and Telescopes," price $2, is most interesting to anyone who looks at the heavens.

(12537) H. R. G. asks: Will you please tell me what is the scientific explanation of the fact that a person can be lifted by the forefingers of two persons if they inhale at the same moment? A. It is safe to say that there is no scientific explanation needed for the fact that two persons can lift a person by their forefingers. The writer used to lift 150 pounds with one little finger, and feels no surprise that two persons should lift the same weight by using four much stronger fingers for the purpose. The inhaling of the breath diverts the attention of the persons from the act of lifting, and they usually say they do not lift at all. But to raise a person weighing 160 pounds, that weight must actually be lifted, and each finger must lift 40 pounds. This is a small weight for a forefinger to lift. We do not think there is any occult force in action here, but just a simple action of the muscular force. We have seen it done without any inhalation of breath at all, and just as easily as when inhaling the breath.

Science

Chinese and Japanese Bells.—Consul S. L. Gracey, stationed at Foochow, calls attention in the *Daily Consular Reports* to the soft and smooth tone of the bells in use at temples and monasteries in China and Japan. The quality of the tone is due not only to the use of excellent material, but also to the absence of iron clappers. The bells are never swung, but are always suspended in a fixed frame, and are sounded by striking them on the outer edge with a wooden mallet.

Masuchika Shimose.—Masuchika Shimose, who invented the high explosive to which the name Shimose powder was given by the Japanese navy, died on September 7th. He was professor of applied chemistry and was born in 1859. For several years he was superintendent of the ammunition department of the naval arsenal, during which time he made extensive researches in connection with explosives. His compound was adopted in 1893 by the Japanese navy, and for his services a decoration and a sum of money were granted to him.

Facts About Mastication.—The force required to crush an ordinary nut, such as one too often sees cracked between the back teeth, has been shown to be equal to a weight of more than 110 avoirdupois pounds, directly applied. The amount of saliva daily secreted by the average male adult is about 1½ liters or 1.59 U. S. quarts. In thoroughly chewing 100 grammes of "Zwieback"—a kind of sweet toasted bread—there is needed half a liter (0.53 U. S. quart) of saliva; in masticating the same amount of apples, only 1/25 liter or 2.44 cubic inches; that is, only 8 per cent, or about one-twelfth as much.

A Shining Metal.—There is a legend among the peasants of Cornwall in England that at night there may be observed a faintly-shining mineral among the rocks brought from the mines. That this is not pure fancy has been proved by Prof. Strutt. A specimen of the mineral autunite, which is also found in Wales, was sent to him from Portugal because of its luminosity. He finds that it closely resembles artificially prepared salts of uranium, and that its luminosity is due to spontaneous radio-activity. The light it sheds is stronger than that of nitrate of uranium. Upon parting with its water of crystallization the mineral loses its luminous property.

The Size of the Oceans.—The Pacific Ocean covers 68,000,000 square miles; the Atlantic 30,000,000; and the Indian Ocean, Arctic and Antarctic Oceans 42,000,000. To stow away the contents of the Pacific it would be necessary to fill a tank one mile long, one mile wide and one mile deep, every day for 440 years. Put in figures the Pacific holds in weight 948,000,000,000,000,000,000 tons. The Atlantic averages a depth of not quite three miles. Its waters weigh 325,000,000,000,000,000,000 tons, and a tank to contain them would have each of its sides 430 miles long. The figures of the other oceans are in the same startling proportions. It would take all the sea water in the world 2,000,000 years to flow over Niagara.

How We Ought To See.—Data have been gathered in Germany with reference to the distance at which persons may be recognized by their faces and figures. If one has good eyes, the Germans claim, one cannot recognize a person whom he has seen but once before at a greater distance than twenty-five meters (eighty-two feet). If the person is well-known to one, one may recognize him at from fifty to one hundred meters, and if it is a member of one's family, even at one hundred and fifty meters. The whites of the eyes may be seen at from twenty-seven to twenty-eight meters, and the eyes themselves at seventy-two to seventy-three meters. The different parts of the body and the slightest movements are distinguishable at ninety-one meters. The limbs show at one hundred and eighty-two meters. At five hundred and forty meters a moving man appears only as an indefinite form, and at seven hundred and twenty meters—2,361.6 feet—the movements of the body are no longer visible.

Let the Red Devil Water Motor Do Your Work

6-inch Motor. Improved construction, absolutely perfect, runs your washing machine and a hundred other things. Power for small tools. ¾ horse power on ½-inch pipe, 80 pounds pressure; 1 horse power on 2-inch pipe, 80 pounds pressure. New net price, $5.00 cash with order.

No. 1492 4-inch Motors for grinding, polishing and buffing. Runs sewing machines, fans, bottle washers, etc. Price with emery, buffing wheel, silver polish and pulley, $3.00. No. 1493 Motor and pulley only $2.50. ¼-horse power on 80 pounds pressure. Improved construction. Speeds, 2,000 to 5,000 revolutions per minute. Only scientifically and mechanically perfect small water motor manufactured. Patented construction makes it possible. Tremendous output warrants the price. Money back for any reason.

6-Inch Bucket Wheel

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For the name of your local hardware tool dealer, we will send you free booklet on "Theory and Design of Water Motors."

DID Beachy have confidence in his Curtiss Motor when he flew over Niagara Falls and under the Bridge?

Everybody knows he must have had absolute confidence. Are YOU going to have as much confidence in the motor YOU are going to install in YOUR aeroplane?
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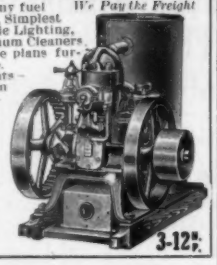

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Aeronautics

Fatal Aeroplane Accidents in America.—On September 2nd Captain John J. Frisbie, one of the most daring and best of our aviators, fell to his death in Kansas while making an exhibition flight. Frisbie did not wish to make the flight, but he did so to please the public. His machine, which was equipped with a Gnôme motor, is said to have turned completely over when flying in a gusty wind. On September 4th, Alexander McLeod, of Winnipeg, Canada, fell from a Curtiss biplane while making a flight at Chicago. McLeod's neck was broken, and he was fatally injured.

The Transcontinental Flight.—The transcontinental flight for a prize of $50,000 offered by a New York newspaper, has drawn forth no less than eight entries to date. Besides Mr. Robert G. Fowler, the Wright pilot whom we mentioned in our last issue, the Wright aviators, Rodgers, Parmalee, and Atwood, and the Curtiss aviator, James J. Ward, are planning to compete in their biplanes, and Earl L. Ovington expects to attempt the flight in his Blériot monoplane. In addition to the above-mentioned aviators, Mr. James V. Martin expects to try for the prize in a new headless biplane of his own design, and Mr. A. V. Reyburn, Jr., of St. Louis, has also entered. Mr. Ward is making the chief effort to fly from New York and win the prize. He will be accompanied by a special train containing an extra machine and plenty of spare parts. The indications are that there will be a lively cross-country competition for this prize before the month is over.

Mr. Glenn Curtiss's Ideas on Aeroplane Development.—Glenn H. Curtiss has had more experience than any other man with regard to the naval aeroplane, and he has recently made a statement summarizing the points upon which the aeroplane needs improvement for military and naval use. He believes that the first requisite is the ability to fly under all sorts of weather conditions, especially in strong winds. His own machines have demonstrated their ability in this direction, as we have already noticed. The points of improvement given by Mr. Curtiss are the following 1. Degree of safety when operated in rough weather. 2. Speed in altitude climbing. 3. Scope of vision of operator and passengers. 4. Facility for alighting on either land or water and rising from either at will. 5. Factors of safety in design and construction. 6. Weight carrying. In addition to these, further credits should be given for small extent of surface offered as a target, for ability of either occupant to operate the machine without inconvenience, for speed in packing and unpacking, and for facilities in launching the machine from a confined space.

Record Flights at the Boston Meet.—The Boston meet was brought to a close on September 6th after a number of record flights had been made. The chief of these was the 160-mile cross country race for monoplanes, with a $10,000 prize to the winner, which was flown on Labor Day. The course was from Boston to Nashua, N. H., to Worcester, Mass., Providence, R. I., and return to the aviation field at Squantum. Mr. Ovington, on his Bleriot monoplane, and Arthur Stone on a Queen monoplane were the only competitors, while in a biplane race over the same course, Lieut. Milling, in a Curtiss, and Harry M. Atwood in a Wright, were the only competitors. Atwood carried his father as passenger, but only flew 12 miles before he was obliged to descend on account of motor trouble. The same was the case with Stone, who only covered about 10 miles before he was obliged to alight. Ovington completed the course in 3 hours and 6 minutes, alighting at each of the cities mentioned. Lieut. Milling lost his way before he reached Nashua and he was obliged to alight at Concord and inquire which way to go. Owing to this and other delays he did not finish the race until after dark. He was awarded the first prize of $7,500, his time for the flight being 5 hours and 22 minutes. Another feature of the meet was the winning of the 33-mile race to the Boston Light and back twice over, by Grahame-White in his Nieuport in 27·35 1/5. This is the fastest time ever made over this course.

"Fame Follows Where Everitt Goes"

The 1912 Self-Starting Everitt "Four-36"
Price, Fully Equipped, $1500

The New Everitt Models—The "Six", The "Four" and the "Thirty" Are Ready For Your Inspection At A Nearby Dealer's—See Them

THE recent announcements of the 1912 Everitt have literally amazed the country. The values offered are so unusual and unexpected that it is little wonder their possibility has been freely doubted.

It has even been said, by some, that if such a car as the Everitt Chrome-Nickel Self-Starting Six could really be sold for $1850, no man in his right senses would think of buying any other if he could get an Everitt.

Other manufacturers have frankly admitted this. They did not see how we *could* do it; they did not believe we *would* do it.

But the proofs are open to anyone. The affidavits of famous steel-makers; an inspection of our factory; the record of the men behind the car—most of all, its own test, in your hands—show conclusively that these cars have really "bridged the gap between the $1500 price and the $4000 quality."

Chrome-Nickel Steel Construction

To those who know anything of fine steels, no argument is needed to show the superiority of Chrome-Nickel. A Chrome-Nickel Steel car—as any engineer can tell you—is about three times the usual strength.

The new Everitt Six and Four-cylinder cars are built throughout of this incomparable material, making them well-nigh unbreakable and unwearable in service. So far as known, these are *the only cars*, selling below $4000, in which this matchless steel is used to any extent.

This material comes from two of the best producers of fine steels in this country—the Billings and Spencer Company, and the Crucible Steel Company of America, at a cost of nearly three times what "good automobile steel" commands.

The affidavits of these two great concerns—showing beyond question that the Everitt is entirely constructed of Chrome-Nickel Steel—have recently been reproduced word for word in our public announcements.

Every Desirable and Modern Feature

In addition, these cars are provided with a Compressed Air Self-Starter which starts the motor and pumps the tires. The wheels are big and massive, and provided with Demountable Rims. The design is clean-cut and handsome, with all levers and door-handles inside. Full equipment, with everything of the best, is included.

Except for size and number of cylinders, the new "Four" shown above, is practically a duplicate of the "Six". Both these cars, with the famous "Everitt Thirty," are beyond comparison from the standpoints of reliability and service.

We invite you to see these new models at your earliest opportunity. The brief specifications of the Everitt "Four-36" are as follows:

Wheelbase, 115 in.; Wheels and Tires, 34 x 4 in.; Horsepower, 36; Demountable Rims; Honey-Comb Radiator; Long Stroke Motor; Compressed Air Self-Starter and Tire Pump; Chrome-Nickel Steel Construction Throughout; Top; Windshield; Speedometer, and Prestolite included. Price, $1500.

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Send catalog and name of dealer

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Running Water in the Country Home Without Fuel Cost

A pumping engine costs you money for fuel every minute it runs—a windmill runs only when there is wind—both constantly require repairs—but, the

Niagara Hydraulic Ram

continuously pumps water 24 hours a day, without cost of fuel, year after year without necessity of repairs. Write at once for catalogue AA and guaranteed estimate.

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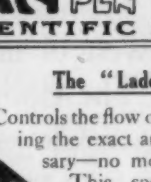

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BUILT ON SCIENTIFIC LINES

The "Gold Top Feed"
Keeps the pen point or nib wet with ink so that the pen writes the minute it touches the paper.

The "Ladder Feed"
Controls the flow of ink, supplying the exact amount necessary—no more—no less. This special feature makes it impossible for the pen to **blot** or **skip** and insures comfort and pleasure in writing.

The "Screwdown Cap"
Creates a vacuum around the nib so that it is impossible for the pen to leak no matter in what position the pen is carried.

"SWAN SAFETY" FOUNTPENS
can be purchased at all stationers and jewelers in any part of the world where pens are sold. $2.50, $3.50, $4.00, $5.00 and up.

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AVIATION

The OCTOBER MAGAZINE NUMBER of the SCIENTIFIC AMERICAN ISSUE OF OCTOBER 14th, 1911

The next mid-month number of the Scientific American will bear the date, October 14th, 1911.

A large part of the number will be devoted to the more practical aspects of flying.

Of these aspects, perhaps the most dramatic, the one which interests the casual reader most, is the use of the flying machine in war. In an article entitled "Dropping Bombs from Aeroplanes", Lieut. Scott draws a vivid picture of the conflict of the future, and tells in what manner the soldier of the air will direct his course over an enemy's camp, and drop shrapnel upon the helpless troops beneath. The chief problem to be solved is that of directing the projectile accurately, which phase of the subject Lieut. Scott discusses with the fullness and directness that may be expected of a West Point man.

In three recent European races, Lieut. Conneau won $100,000. The sum is huge, but not nearly so huge as other figures in this newest of industries. In an article entitled "The Business Side of Aviation", Mr. Grover Cleveland Loening will tell what it costs to race, what a flight like that of Atwood's from St. Louis to New York means in dollars and cents, what enormous profits are made by the manufacturers of aviation motors and aeroplanes themselves.

Not until the engineer steps in and designs a machine which will fly fast with the least possible engine power will the aeroplane take its place as a pleasure vehicle which any one may use. Much scientific research is necessary before that time will come, to determine the best form of plane. What physicists are doing in the laboratories of great universities to solve that problem is revealed in an article which bears the title "Progress in Aerodynamics".

Every amateur who takes the most superficial interest in aviation considers himself competent to design an aeroplane. He knows nothing of the basic principles laid down by Langley, Chanute, Maxim and the Wright brothers. The result is machines that are aviation absurdities. In a merrily written and biting article, which is fittingly entitled "The Chamber of Horrors", these freaks are riddled.

Besides these articles on aviation, the mid-month number for October will contain the usual Scientific American material, abstracts from current periodicals, the inventor's department, and articles on recent achievements in science and industry.

The whole number will be incased in a colored cover by Mr. William Harnden Foster.

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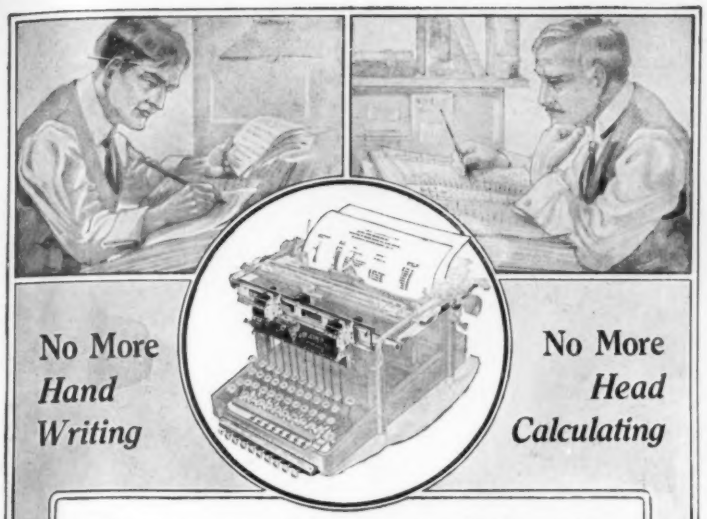

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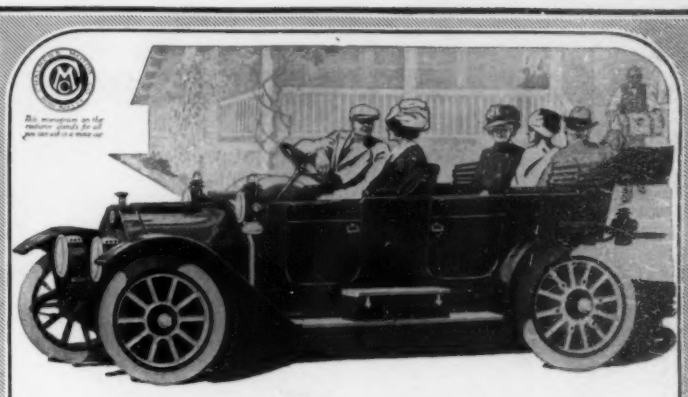

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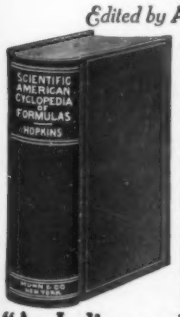

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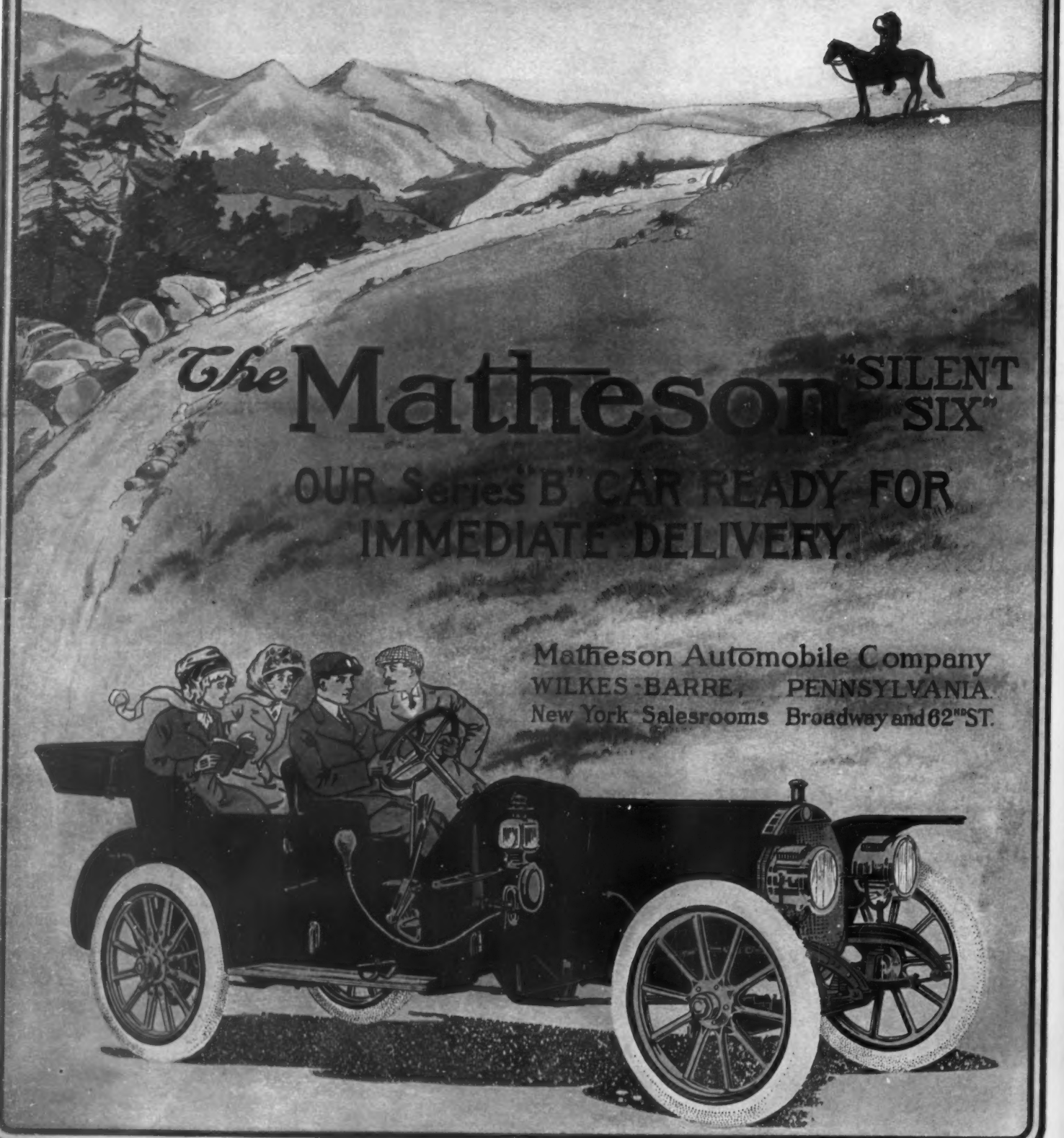

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